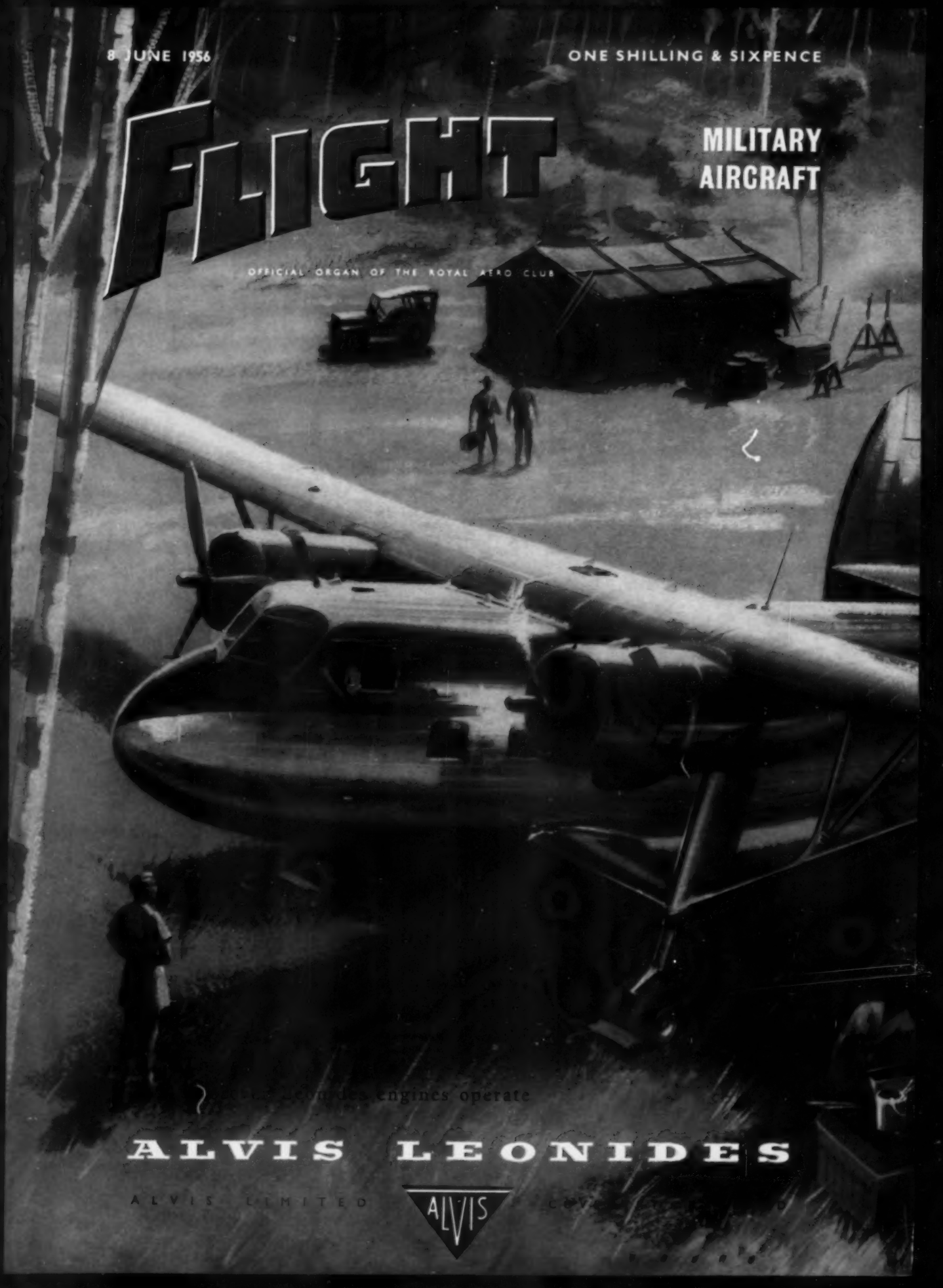
8 JUNE 1956

ONE SHILLING & SIXPENCE

FLIGHT

MILITARY AIRCRAFT

OFFICIAL ORGAN OF THE ROYAL AERO CLUB



engines operate

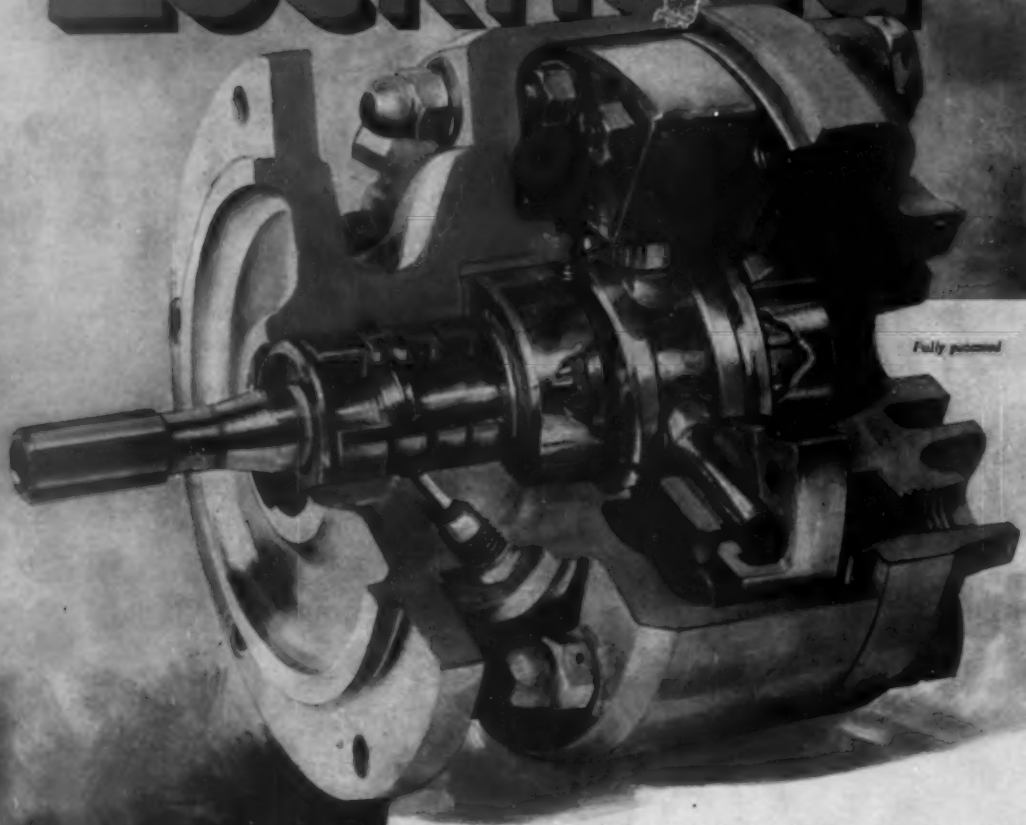
ALVIS LEONIDES

ALVIS LIMITED

ALVIS

ALL-BRITISH

Lockheed



Fully patented

The Lockheed Mark 7 pump is one of the famous Lockheed range of engine-driven pumps, and the widely-used Mark 8 pump is in effect a two-bank version of the Mark 7.

These pumps have earned a fine reputation and form the heart of the hydraulic system of many fine aircraft.

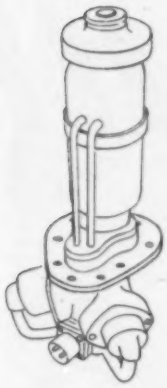
Lockheed equipment is based on continuous experience of hydraulic specialization since 1928, and includes Lockheed operating jacks, 'Servodyne' powered flying controls, and undercarriage shock-absorber struts.

AUTOMOTIVE PRODUCTS COMPANY LIMITED
LEAMINGTON SPA, ENGLAND

FOREMOST IN HIGH-PRECISION HYDRAULICS

Regd. Trade Marks: Lockheed, 'Servodyne'

VALVE VERSATILITY



In the aircraft industry, not all design advances are spectacular. Relatively unseen improvements make a vital contribution to aviation progress. Such a contribution is a new approach to fuel system requirements evolved recently by Flight Refuelling Ltd., pioneers of pressure refuelling.

Lightweight, high efficiency, multi-purpose components have been developed which, by combining 2 or more functions in a single unit, reduce multiplicity of fuel lines and simplify the planning of complete fuel systems of any capacity.

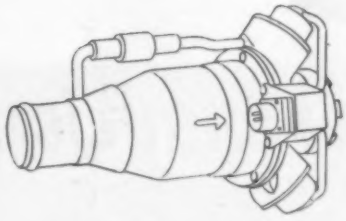
The fuel system now becomes a carefully integrated whole, with all component parts, from filling point to engine feeds, designed to provide the maximum of efficiency with the minimum of weight.

FR PRESSURE REFUELLING COMPONENTS—ALL ALONG THE LINE!

Mark 27 **In-line Dual-purpose Valve**
Designed for refuelling, defuelling and fuel transfer. Electrically operated; rated flow 50 g.p.m. Weight 2 lb. 14 ozs.

Mark 32 **Double Shut-off Valve**
Tank mounted, electrically operated. Double shut-off feature gives added safety factor where structural design prevents adequate venting. Weight 3 lb. 12 ozs.

Mark 29 **In-line Dual-purpose Valve**
Similar to the Mark 27, but with the transfer side of the valve servo-operated by independent float mechanism so that in the event of electrical failure the valve will automatically close to prevent air transfer to engines.



FLIGHT REFUELLING LIMITED

Tarrant Rushton Airfield, Dorset
Tel.: Blandford 501
Grams: Refuelling Blandford

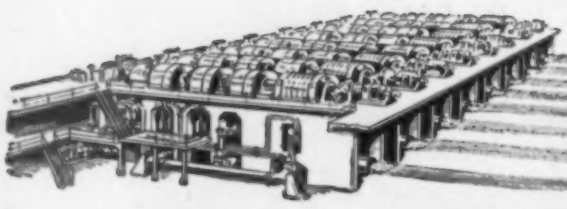
TA9191

350,000 HP!

Air compressor requirements of an entirely new conception arise from the vast field of modern aeronautical research. Under construction by the G.E.C. is what is believed to be the largest compressor installation in the world. This test equipment, to Ministry of Works order, covers eight turbine and motor driven compressor/exhauster sets of 44,000 h.p. each.

G.E.C.

advances aeronautical research



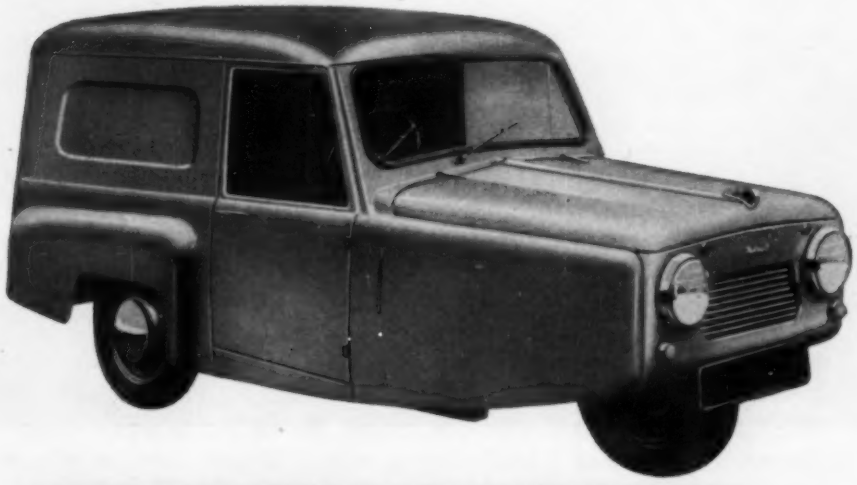
T.110

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2.

Moulding the future . . .

Three wheels mean £5 tax instead of £12—if the van weighs less than 8 cwt. But . . . install a sturdy chassis, a 4-cylinder, water-cooled engine, a 4-speed and reverse gear box, a car-type rear axle with differential and 3 car size wheels—and what have you left for body weight! And come to that body *cost*! The bright answer is F.R.P.—as applied to this 5-cwt van by the Reliant Engineering Co. (Tamworth) Ltd. This tough little customer has a featherweight body with a heavyweight's strength. Its many curved panels, which would have cost a fortune to form by hand, were perfectly and simply moulded. There you have Fibreglass to the core!

Fibreglass have an advisory service which is expert, confidential and free.



FIBREGLASS
TRADE MARK

the backbone of Reinforced Plastics

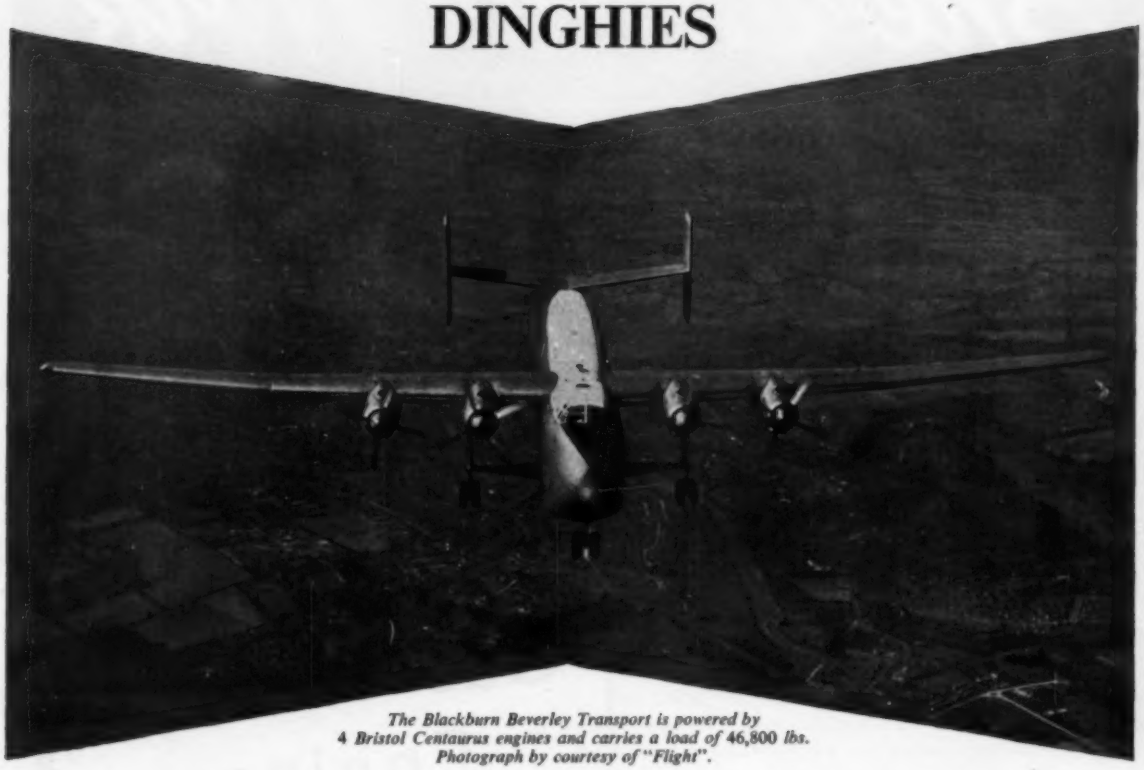
FIBREGLASS LIMITED, RAVENHEAD ST. HELENS LANCS. TELEPHONE ST. HELENS 4224

Aircraft components by

S. E. OPPERMAN LTD

BOREHAM WOOD, HERTS. ELSTREE 2021

Beverley Transport carries
ELLIOT INFLATABLE
DINGHIES



The Blackburn Beverley Transport is powered by 4 Bristol Centaurus engines and carries a load of 46,800 lbs. Photograph by courtesy of "Flight".

ELLIOT 20-man dinghies are specified for the Beverley Transport aircraft now in production for the R.A.F.

Elliot Equipment Ltd. are designers, manufacturers and suppliers of Inflatable Dinghies and other inflatable life-saving equipment for the Royal Air Force and Fleet Air Arm. The Company has given particular attention to the development of the larger types of inflatable dinghies.

The Royal Navy has adopted Elliot Inflatable Life-rafts as standard equipment and they are specified for H.M.Y. *'Britannia'*.

ELLIOT EQUIPMENT LIMITED

One of the P.B. Cow Group

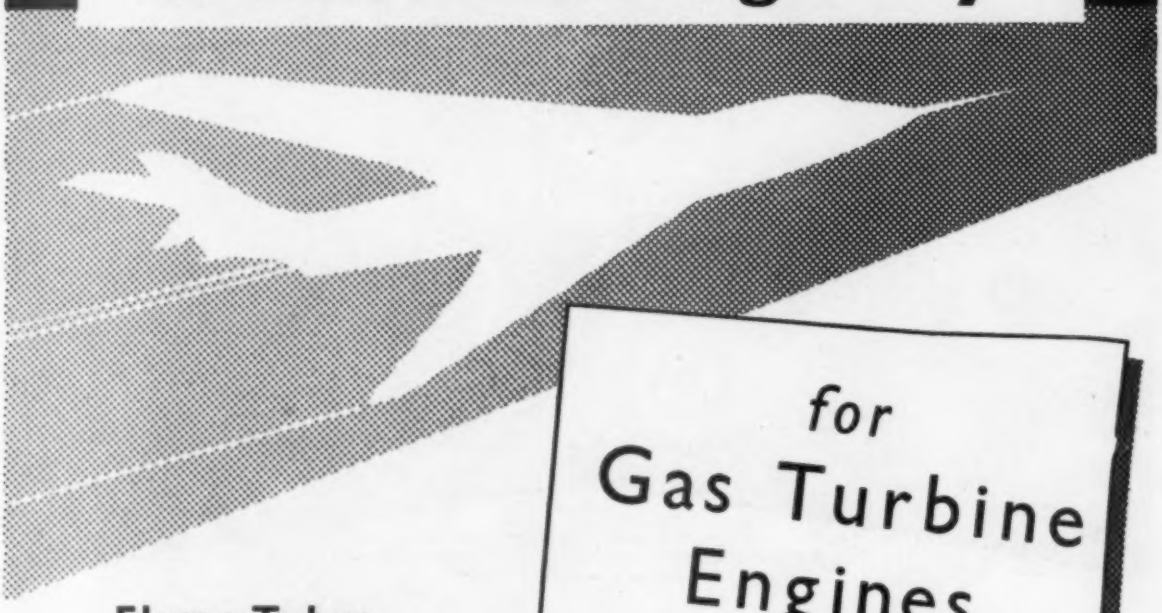
Llwynypia, Rhondda, South Wales

Tel.: TONYPANDY 3232

PRECISION

Sheet Metal Work

in heat-resisting alloys



for
Gas Turbine Engines

- **Flame Tubes**
- **Jet Tubes**
- **Nozzle Boxes, etc.**

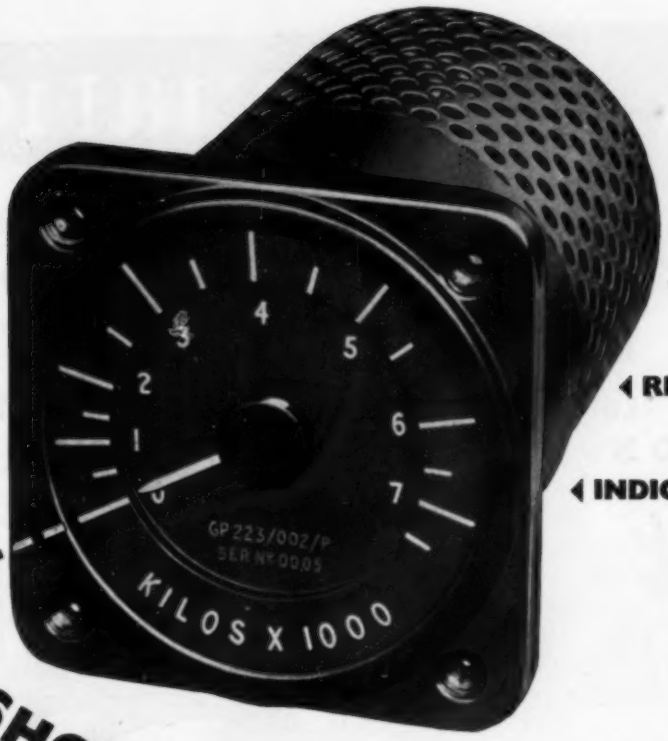
First-class development and production facilities offered to manufacturers

Fully approved A.I.D. and A.R.B.

V.P. SHEET METAL LIMITED

WINDSOR STREET . CHELTENHAM

Telephone: Cheltenham 5805



HOW COMPACT SHOULD A FUEL GAUGE BE ?

AS COMPACT AS TYPE 2 PACITOR. Indicator, Oscillator and Rectifier are all combined in one unit. That makes it the most compact aircraft fuel gauge in the world — and therefore the easiest to install and service. For maintenance work, there's no need to scramble all over the aircraft amid a mass of complicated wiring — you simply take out and replace the whole unit. It's literally a two-minute job. Type 2 Pacitor is one of the *lightest* aircraft fuel gauges available —1 lb. 8 ozs. plus the new lightweight tank unit. And we haven't sacrificed performance. For all its compactness the gauge is second to none for accuracy. It indicates the contents of individual tanks or several tanks summated. Type 2 Pacitor is in full production and available NOW — with water-in-fuel detectors if you want them.

Simmonds Aerocessories are a Ministry of Supply Design Approved firm for fuel contents gauges. Type 2 Pacitor has been accepted by the Air Registration Board.

TYPE 2 PACITOR ELECTRONIC FUEL CONTENTS GAUGE

Enquiries to: **SIMMONDS AEROCESSORIES LTD.,**
Byron House, 7-8-9, St. James's St., London, S.W.1.
Head Office and Works: Treforest, Pontypridd, Glamorgan.

Branches: Birmingham, Stockholm, Copenhagen, Ballarat, Sydney, Johannesburg, Amsterdam, Milan & New York

A MEMBER OF THE FIRTH CLEVELAND GROUP

CRC 377P

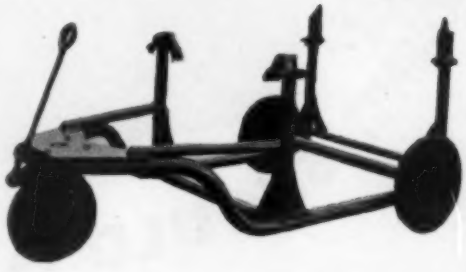
Serving Aviation

World Leading Gas Turbine Power Plants

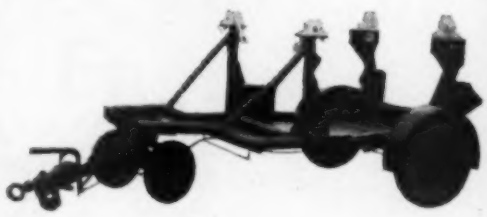
by ROLLS-ROYCE LIMITED

HANDLED BY EQUIPMENT DESIGNED AND MANUFACTURED BY
AVIATION TRADERS (ENGINEERING) LTD.

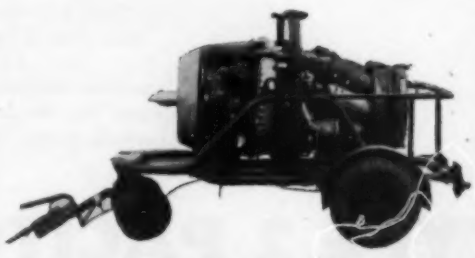
First The "AVON" Workshop Trolley



Then The "AVON" Road Trailer



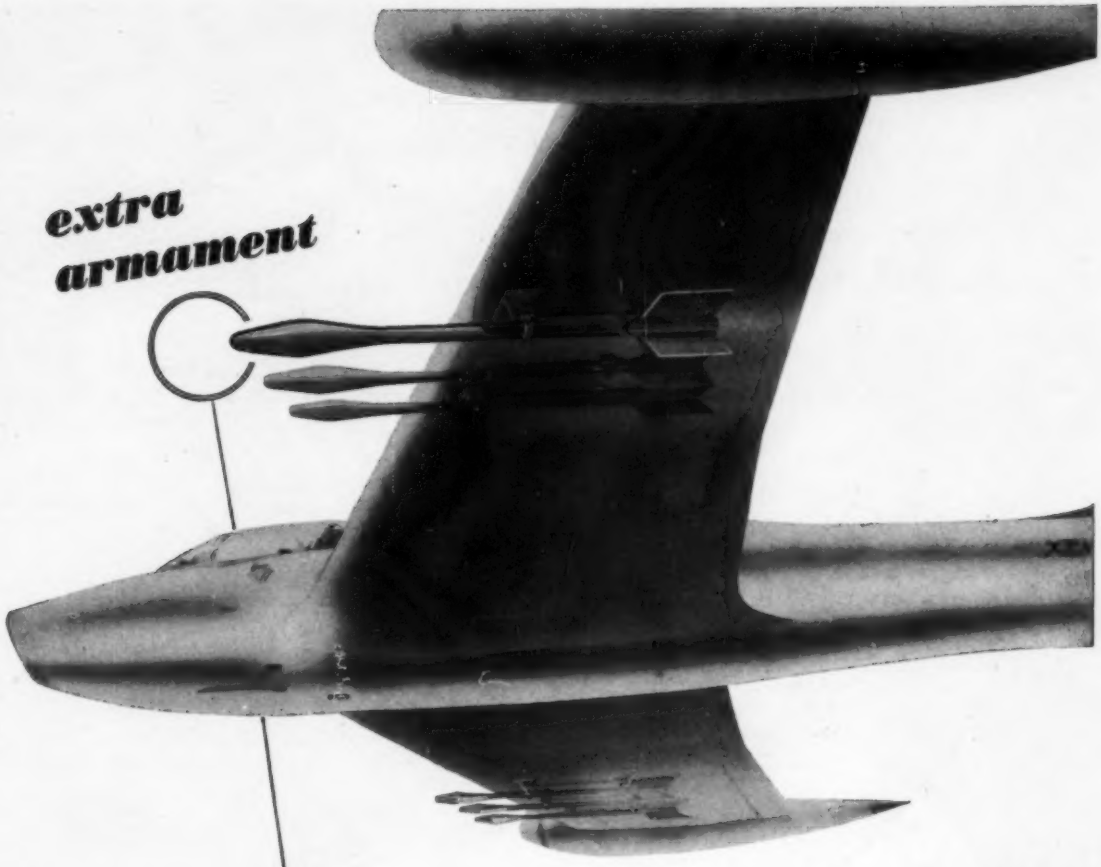
Now The "DART" Road Trailer



HIGH EFFICIENCY IN THE AIR—
SMOOTH, QUICK AND ECONOMICAL HANDLING
ON THE GROUND

Telephone: AMBassador 2091 (5 lines). Telegrams: AVIATRADE, WESDO, LONDON

AVIATION TRADERS (ENGINEERING) LTD.
15, GREAT CUMBERLAND PLACE LONDON, W.1.



extra armament

instead of oxygen cylinders

An oxygen supply equivalent to that provided by 6 standard 750 litre storage cylinders can now be stored, in its liquid state, in a converter of only 5 litres liquid capacity. This liquid oxygen converter, which Normalair have made available to the British aircraft industry, weighs only 29.5 lb. when fully charged, and occupies only 0.7 cu.ft. A comparison between these figures and those for storage cylinders shows savings in weight and space of approximately 60 lb. and 3 cu. ft. respectively. Normalair will be pleased to give advice concerning the use of liquid oxygen converters.

NORMALAIR (Canada) LTD.
922 King Street West, Toronto

NORMALAIR LIMITED · YEOVIL · ENGLAND

NORMALAIR (Australia) PTY. LTD.
70 Cape Street, Heidelberg,
near Melbourne, Victoria

Standard Equipment with the **RAF**

R.F.D. COMPANY LTD

A R B Design Approved
M O S Design Approved

SINGLE SEAT LIFERAFTS

Designed for high speed aircraft fitted with ejector seats.
Mk. 3A LIFERAFT illustrated.

R.F.D. COMPANY LIMITED · GODALMING · SURREY · ENGLAND

Telephone: Godalming 1441 · Cables: Airships, Godalming

Also R.F.D. Overseas Companies in

NORTHERN IRELAND · AUSTRALIA · CANADA · AFRICA · HOLLAND · SWEDEN · FRANCE

we shape the things to come

Records in height, speed and distance mean skill and enterprise in the air.
Skill and enterprise in prototype production are the proud claim of the Abbey Panel and Sheet Metal Co. Ltd.

Tomorrow
is in our hands today

We know, from very successful past experience, that tomorrow's demands on both design and construction can only be met with skill and up-to-date production methods. We employ none but the finest craftsmen and are recognised as being among the foremost specialists in Sheet Metal manipulation in the country.

The Abbey Panel & Sheet Metal Co. Ltd.

OLD CHURCH ROAD
LITTLE HEATH
COVENTRY

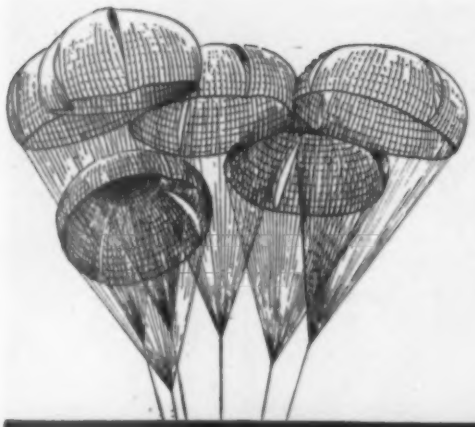
Telephone Nos.: Head Office, COVENTRY 89461 (3 lines)
Aircraft Division, BEDWORTH 2321

A.I.D., A.R.B. and C.I.A. approved

Famous names form a worthy testimonial to the quality of our design and production.

BRISTOL AEROPLANE CO. LTD.
ARMSTRONG SIDDELEY MOTORS LTD
W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
HAWKER AIRCRAFT (Blackpool) LTD.
ARMSTRONG SIDDELEY (Brockworth) LTD.

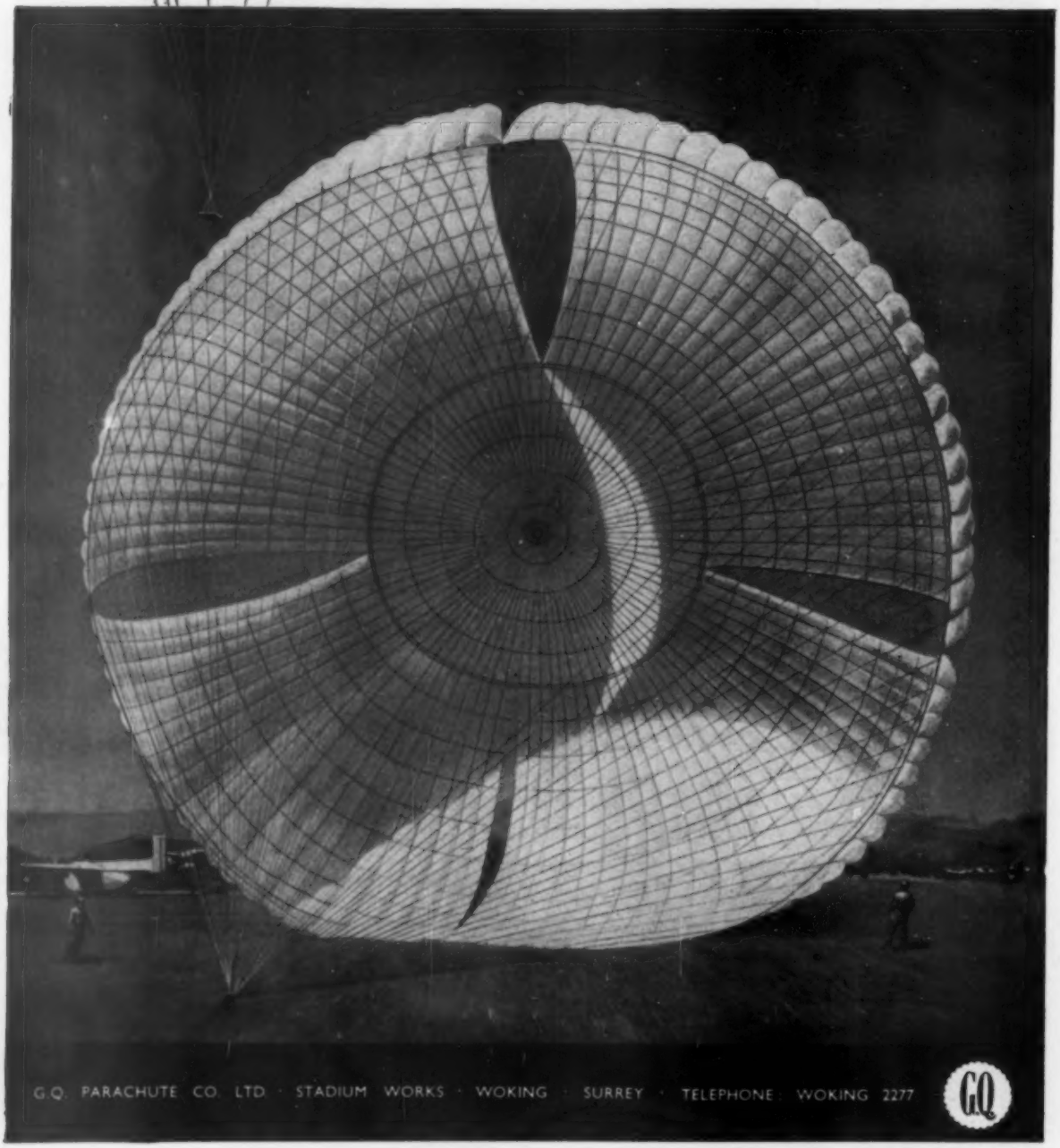
Willington



20,000 LBS BY PARACHUTE

Loads of 20,000 lbs have been dropped successfully from the Blackburn Beverley on 6 G.Q. 66 ft. Dia. parachutes.

These parachutes, which have an individual load capacity of 3,000 lbs, may be easily dismantled into five sections for repair and handling in the field. Like other G.Q. parachutes of advanced design they are extremely stable in flight.



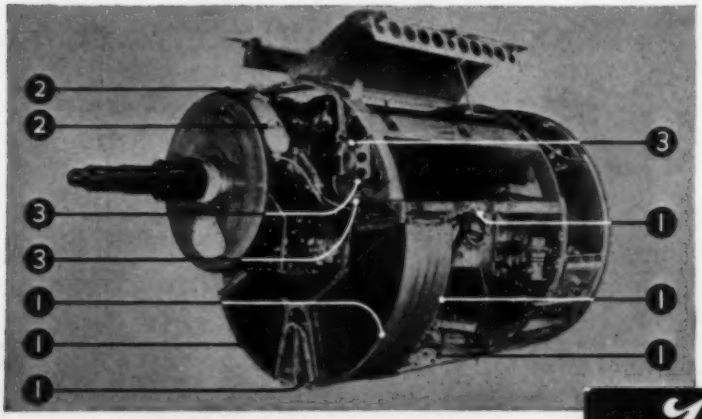
A 101 uses in the Aircraft Industry

"TITEBOND" Adhesive ensures a safe bond

Specification D.T.D. 900/4240 No. 22/23
Specification D.T.D. 900/4114 No. 24

Our Research Department is at your SERVICE. Send us your "Sticky" Problem and we will supply the solution

ROLLS-ROYCE GRIFFON 57 ENGINED POWER PLANT–as fitted in R.A.F. Shackleton Aircraft



We are indebted to Messrs. Rolls-Royce Limited for the above illustrations.
Write for your copy of our illustrated Catalogue, F.9.

SURRIDGE'S PATENTS LTD.

USERS OF "TITEBOND" INCLUDE SUCH WELL-KNOWN ORGANISATIONS AS:—

- British European Airways.
- British Tabulating Machine Company Limited.
- E. K. Cole, Limited.
- McMichael Radio Limited.
- National Coal Board.
- Post Office Factories Department.
- Rolls-Royce Limited.
- Scandinavian Airlines System
- Short Brothers & Harland Ltd.
- Vickers-Armstrongs (Aircraft) Limited.

Applications of Surridge's Patents Ltd. "TITEBOND" 22

(1) Felt to Metal
(2) Langite to Metal
(3) Asbestos to Metal

Holdtite
SURRIDGE'S PATENTS

Beckenham · Kent *Telephone: BECkenham 0168*

When there's something in the air . . .

MARSTON DEVELOPMENTS

are playing their part in Britain's Leading Aircraft

with HEAT EXCHANGERS

'FLEXELITE' FLEXIBLE FUEL TANKS

LAMINATED PLASTIC RADOMES

and other components.

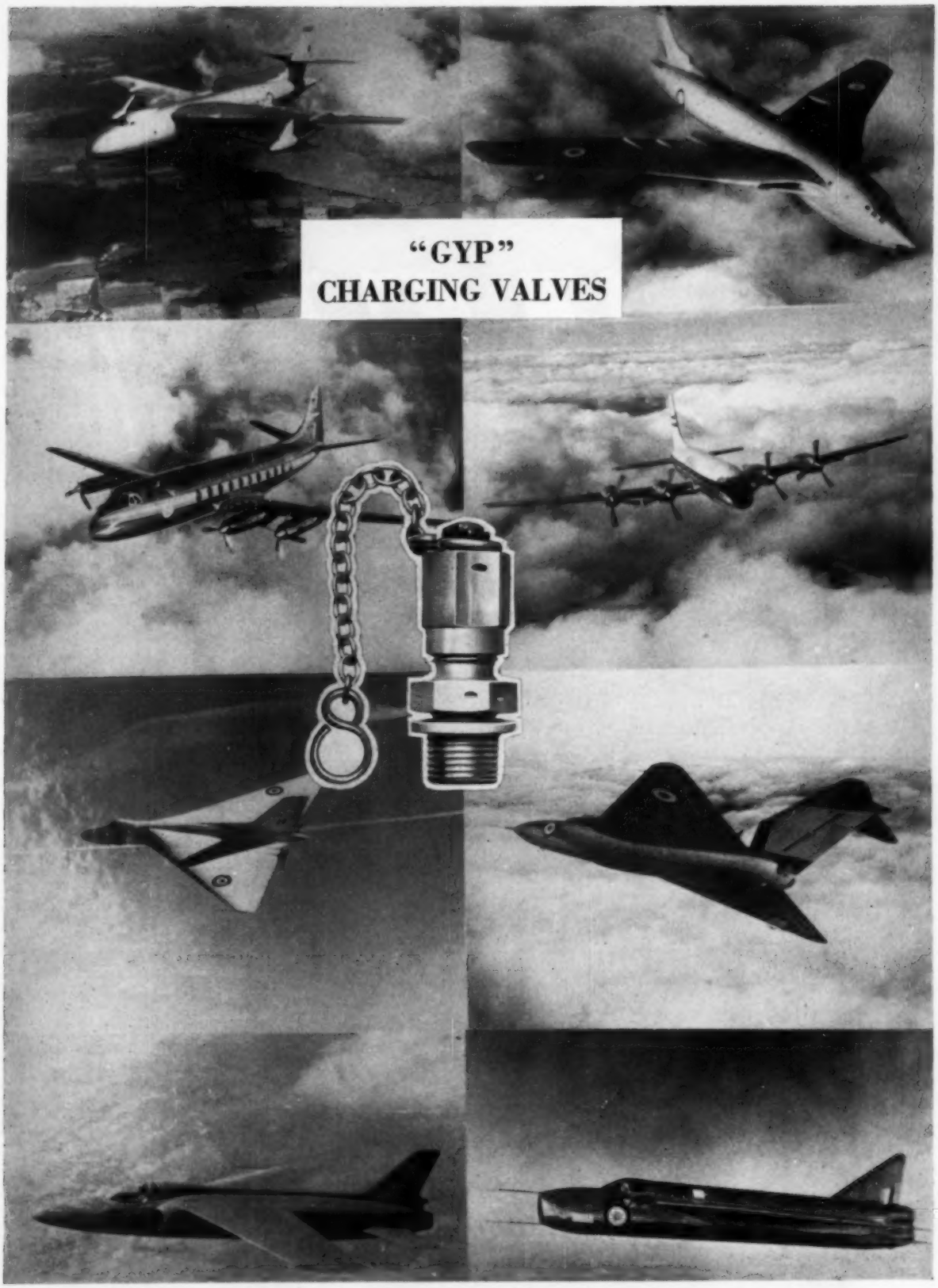
The Marston design and development organisation is approved by the Ministry of Supply and the Air Registration Board— can we help to solve your *problem?*

MARSTON EXCELSIOR LIMITED

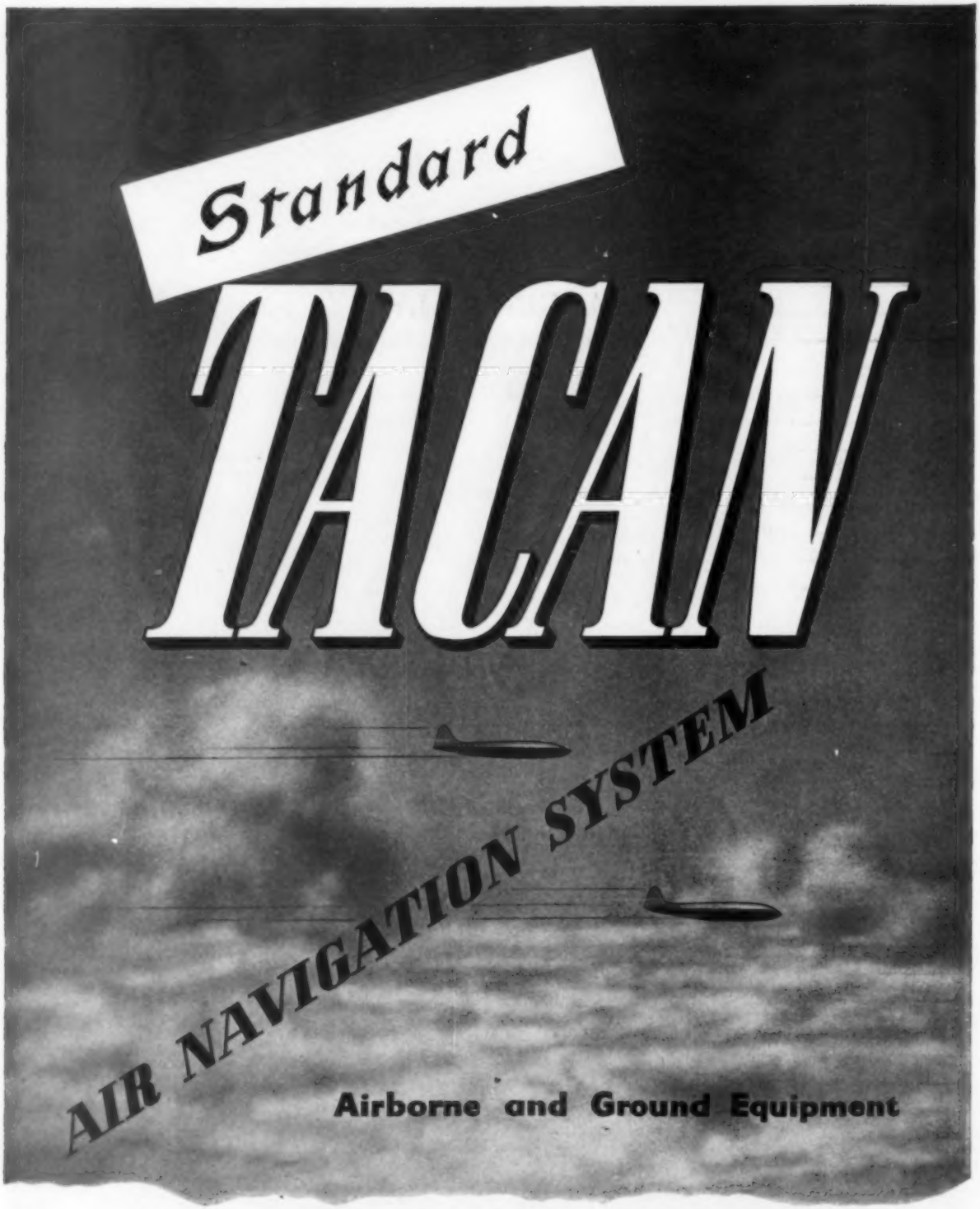
FORDHOUSES, WOLVERHAMPTON Tel: Fordhouses 2181

(A subsidiary company of Imperial Chemical Industries Ltd.)

MAR 172



HIGH PRESSURE COMPONENTS LTD.



Standard Telephones and Cables Limited

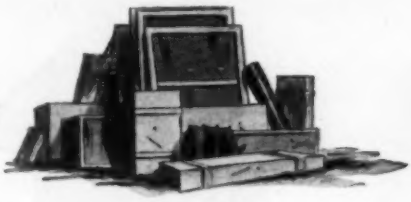
Registered Office: Connaught House, Aldwych, London, W.C.2

RADIO DIVISION: OAKLEIGH ROAD · NEW SOUTHGATE · LONDON N11 · ENGLAND

Take

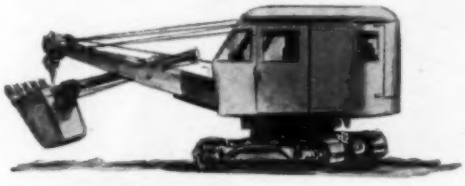
. . . a Constructional Engineer . . .

. . . his assistants . . .

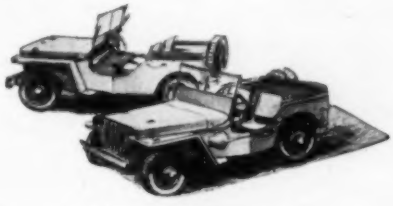


. . . stores . . .

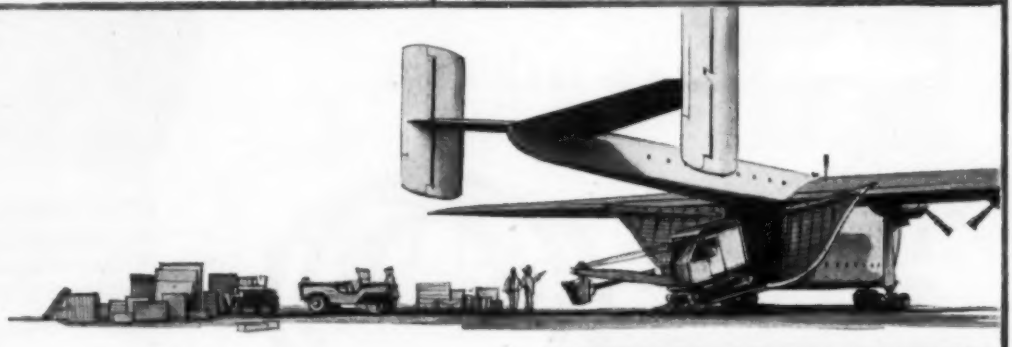
. . . more stores . . .



. . . heavy equipment . . .



. . . base transport . . .



. . . and convey them, in one quick move, in a Universal

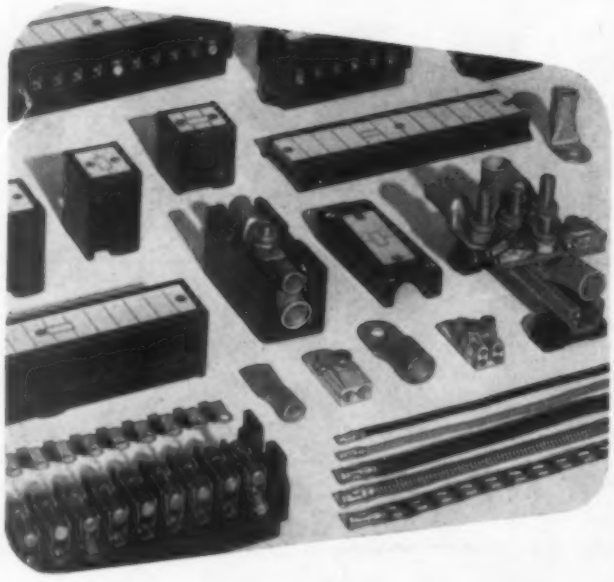
The Universal has a main freight compartment 10 feet high, 10 feet wide, 40 feet long and a payload of 50,000 lb. Forty-two passengers can be accommodated comfortably in airliner type seats in the rear cabin.

Blackburn and General Aircraft Limited. Brough, E. Yorks

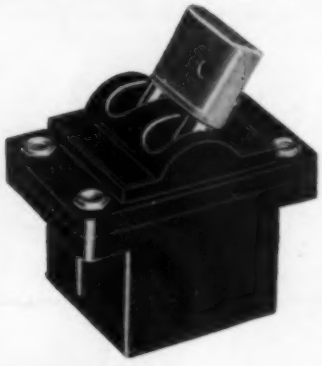
B

Reglo

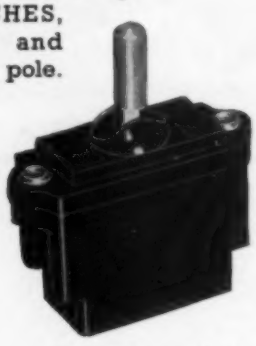
AIRBORNE EQUIPMENT



The complete range of the S.B.A.C. WIRING SYSTEM.



The redesigned range of 20-amp SWITCHES, single and double pole.



All equipment is of the highest quality as demanded by modern aircraft requirements.

All types of CONNECTORS made to customers' specifications.

Your enquiries invited

C. W. C. EQUIPMENT LTD.

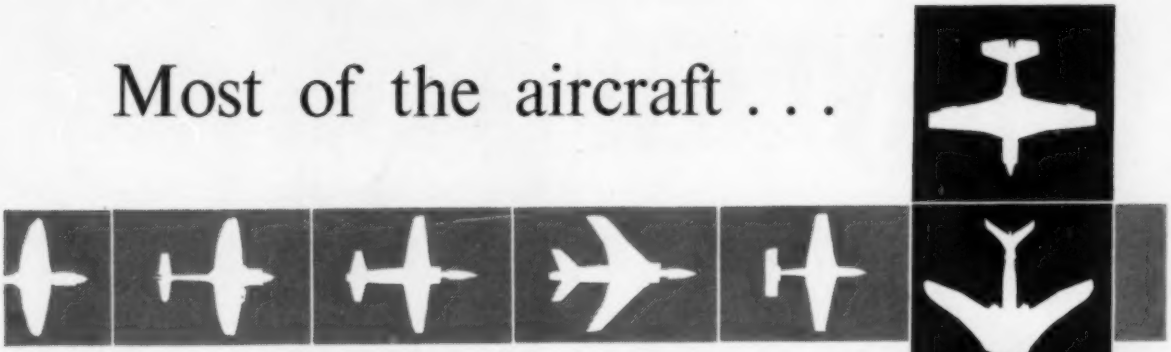
ACORN WORKS, KINGS GROVE, MAIDENHEAD, BERKS.

Telephone: MAIDENHEAD 2275/6/7 *Telegrams & Cables:* DURAQUIP, MAIDENHEAD

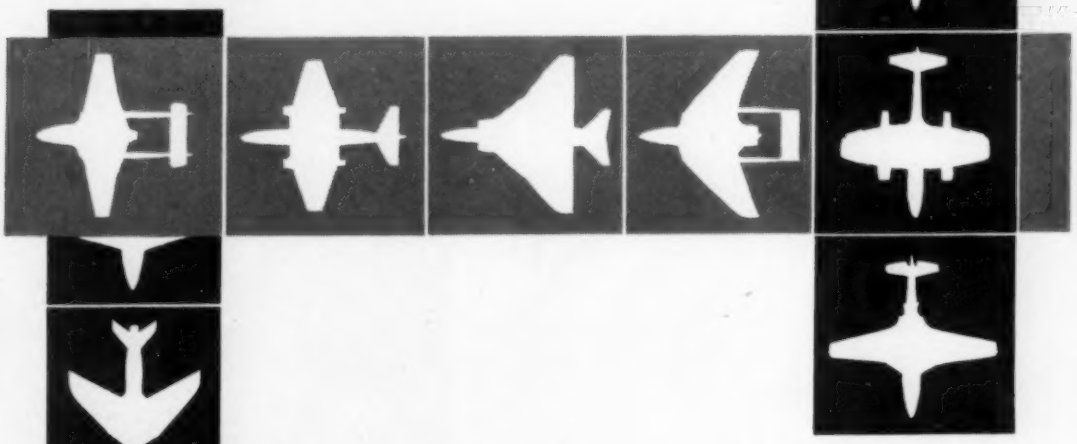
MANUFACTURING ENGINEERS

A.I.D. Approved A.R.B. Approved

Most of the aircraft . . .



Nearly every British aircraft in use with the air forces of the world is fitted with precision control equipment designed and manufactured by Teddington Aircraft Controls Ltd.



. . . use TEDDINGTON

CABIN TEMPERATURE CONTROL SYSTEMS • FUEL TANK PRESSURISATION CONTROL VALVES • TIME SWITCHES	DIFFERENTIAL PRESSURE SWITCHES • DE-ICING CONTROLS • MACH SWITCHES	ANTI-SURGE VALVES FOR OIL SYSTEMS • ELECTRO-MAGNETIC VALVES • ICE WARNING SYSTEMS	ELECTRO-PNEUMATIC VALVES • NAVIGATION LIGHT FLASHER UNITS • INTERVALOMETERS	HOT AIR VALVES • GAS TURBINE AUTOMATIC STARTING CONTROLS • INCHING CONTROLS

Teddington CONTROLS

REGD TRADE MARK

TEDDINGTON AIRCRAFT CONTROLS LTD., MERTHYR TYDFIL, SOUTH WALES. Telephone: Merthyr Tydfil 666.

London Office: COLNBROOK BY-PASS, WEST DRAYTON, MIDDLESEX. Telephone: Colnbrook 502.

TA 149

GRAVINER

CIRCLES THE WORLD...

REGD. TRADE MARK
GRAVINER
MANUFACTURING COMPANY LIMITED

GRAVINER MANUFACTURING CO. LTD.
POYLE MILL WORKS, COLNBROOK, BUCKS. Tel.: COLNBROOK 48

loaded with safety

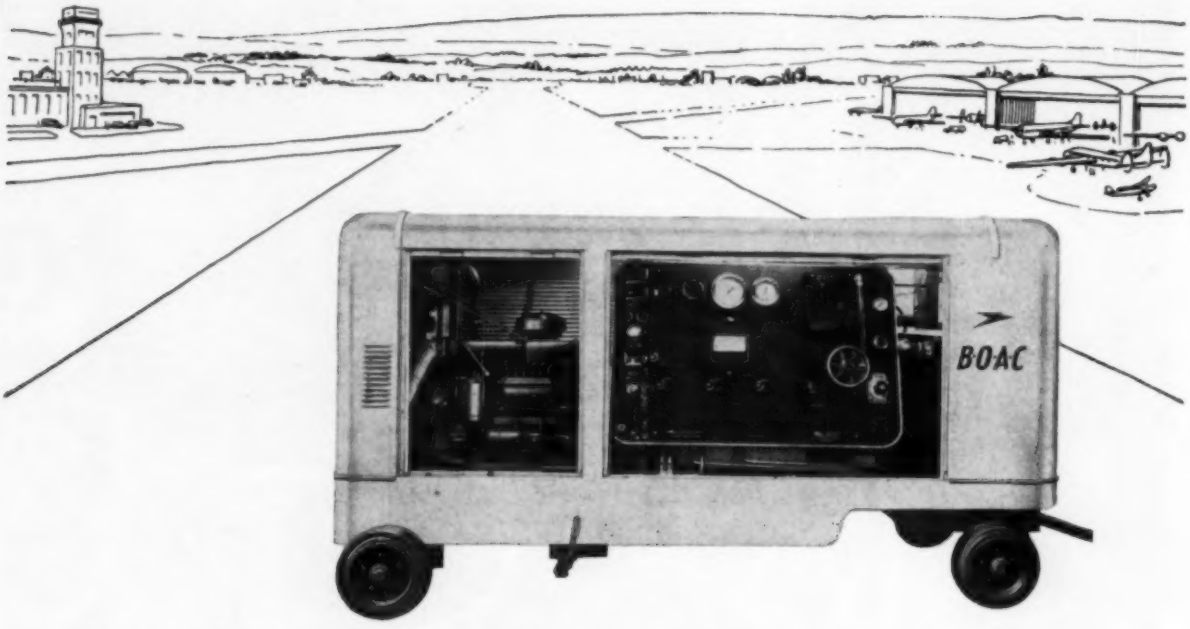
Often eliminating the need for telescoping sleeves, these joints are ideal for use where tension and compression loads occur. Well suited to high speed drives, they are made from 45-50 tons alloy steel to Air Board specification, with hardened steel trunnion blocks.

ME universal joints

HOOKE'S TYPE LIGHT SERIES

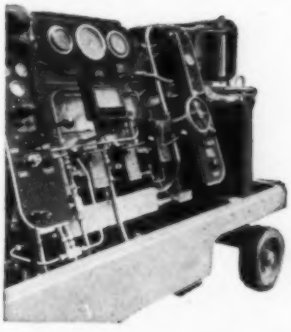
These joints are designed specially for the aircraft industry and are of anodised light alloy. Trunnion pins are hardened and ground steel, cadmium plated. They withstand some tension and compression loads and are available in a wide range of sizes.

AIR MINISTRY GAUGE TEST HOUSE AUTHORITY 89755 31
THE MOLLART ENGINEERING CO LTD
KINGSTON BY-PASS SURBITON SURREY ENGLAND
PHONE: ELMBRIDGE 0033-7 GRAMS: PRECISION SURBITON



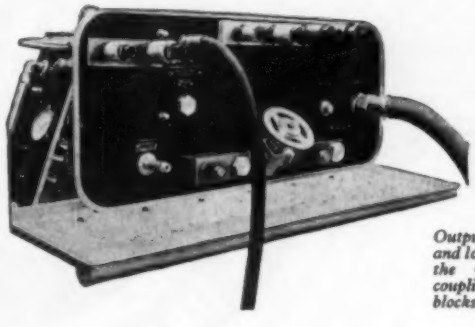
The World's Finest Aircraft Test Rigs

Large numbers of HML Test Rigs are in active service with aircraft operators and manufacturers and a heavy production programme is in hand. Outstanding design, rugged reliability and very high accuracy are the highlights of HML success—plus complete Universality. HML Test Rigs will service *all* types of aircraft and components—and pre-setting takes only 15 seconds.



Three-quarter view of control panel with centre section removed.

HML UNIVERSAL HYDRAULIC TEST RIGS



Output panel showing high and low pressure lines with the various self-sealing couplings and bleeding blocks.

HML (ENGINEERING) LTD. *Aircraft Division*

•Mobile and Static Hydraulic Test Rigs for Aircraft and Components •High Speed Gear Boxes •Hydraulic Equipment for Guided Missiles •Hydraulic Power Units for all Purposes •Piston-type Accumulators •High-Pressure Filters.

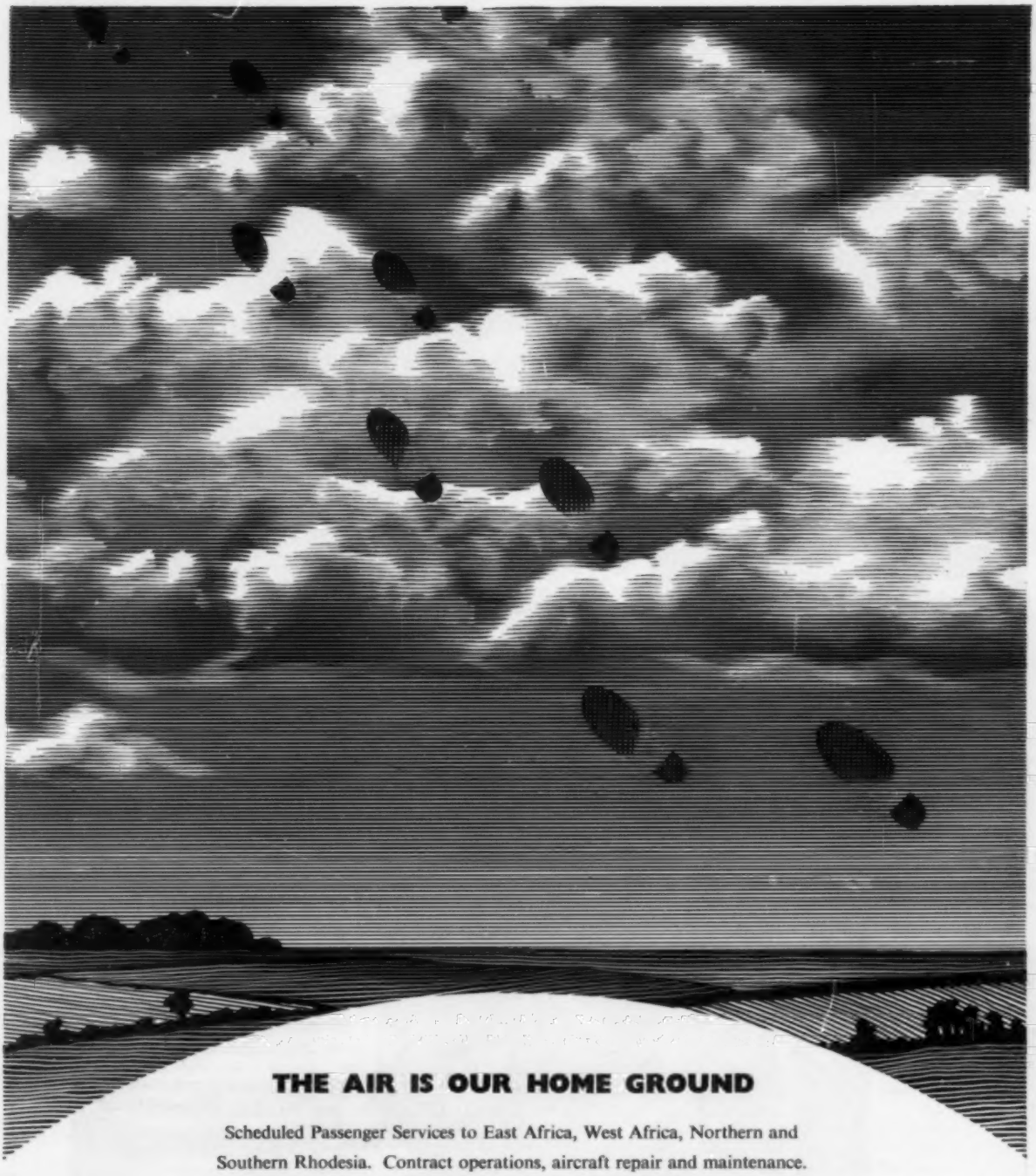
466-490 EDGWARE ROAD, LONDON, W.2. • PADDINGTON 0022 (12 LINES)

DHB/2618

W. VINTEN LTD., NORTH CIRCULAR RD., CRICKLEWOOD, LONDON, N.W.2. • *TEL: GLADSTONE 6373*

TUBE
ROD
BAR
SHEET
STRIP
GAUZE
WIRE-ROPE
CASTINGS
to A.I.D.
and A.R.B.
specifications

THE TUNGUM COMPANY LIMITED · CHELTENHAM · ENGLAND

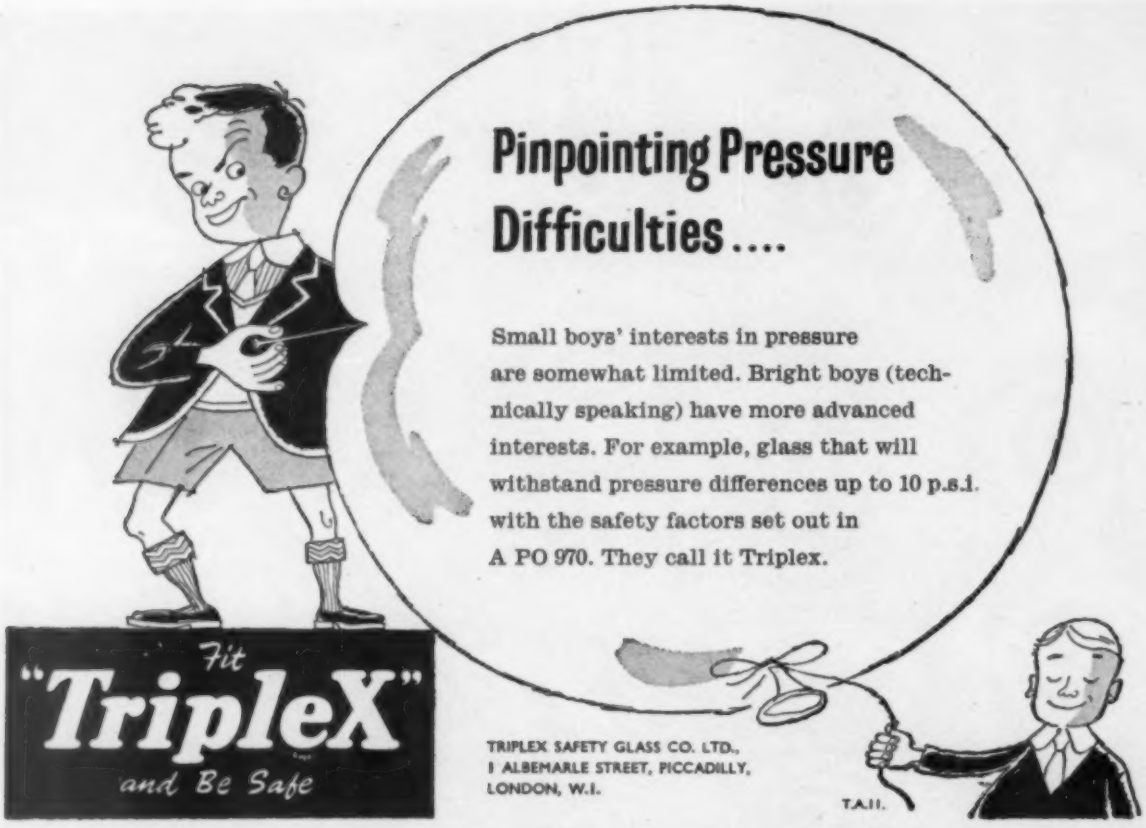


THE AIR IS OUR HOME GROUND

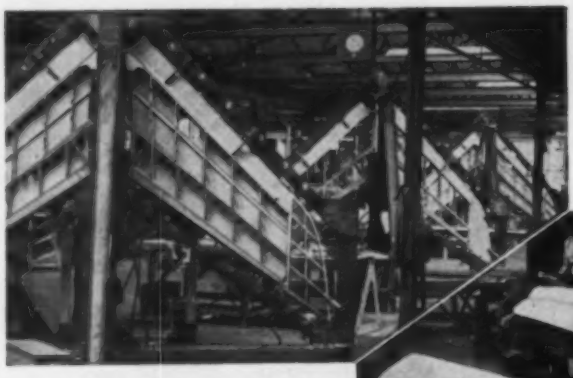
Scheduled Passenger Services to East Africa, West Africa, Northern and Southern Rhodesia. Contract operations, aircraft repair and maintenance. Overseas based operations. Helicopter operations. Crop spraying. Flying training and flying clubs. Aircraft sales and purchase. Spare parts sales and purchase. Radio installation and maintenance. Aircraft catering and aircraft insurance.

AIRWORK LIMITED

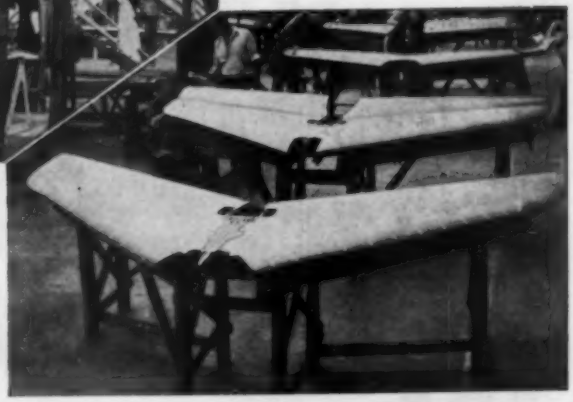
35 PICCADILLY · LONDON W.1. TELEPHONE REGENT 8494


Pinpointing Pressure Difficulties....
Small boys' interests in pressure are somewhat limited. Bright boys (technically speaking) have more advanced interests. For example, glass that will withstand pressure differences up to 10 p.s.i. with the safety factors set out in A PO 970. They call it Triplex.
Fit "TripleX" and Be Safe
TRIPLEX SAFETY GLASS CO. LTD., 1 ALBEMARLE STREET, PICCADILLY, LONDON, W.1.
T.A.11.

SHEET METAL ENGINEERING . . .
for the AIRCRAFT INDUSTRY



★ Our photographs show sections of our extensive works where work is in progress on complete tailplane assemblies for the famous Hawker Hunter jet fighter aircraft.



★ Our long experience and modern equipment, coupled with our high quality and precision workmanship, enable us to offer a specialized service to the aircraft industry. We can make prototype components or equipment and can also produce the tools to do the job. Our spacious workshops can also handle quantity production.

Full information available from Dept. F.1/56.

E. G. Brown & Co. Ltd

WEST ROAD, TOTTENHAM, LONDON, N.17

Taxes, submarines and Seamews

The submarine is now an even greater potential menace to Britain and other countries dependent on overseas supplies. This would be true whether nuclear weapons were used or not. Submarines might be the carriers of such weapons. In any event nuclear motors would greatly increase the range of submarines. Future anti-submarine operations would inevitably call for large numbers of search-and-strike aircraft, first, because coastal defence requires continuous air patrolling and, secondly, so that convoys, endangered at sea, could quickly put up an anti-submarine 'umbrella'—off improvised carriers—in any weather. In heavy weather, submarines, moving through relatively calm waters, have a mobility advantage over surface craft and are, therefore, a greater menace. Britain and N.A.T.O. countries, already heavily taxed to pay for the last war and anxious to guard against a possible next, are turning to weapons like the Short Seamew, designed for fully effective performance in action yet within a nation's capacity to build quickly, cheaply and in large numbers.

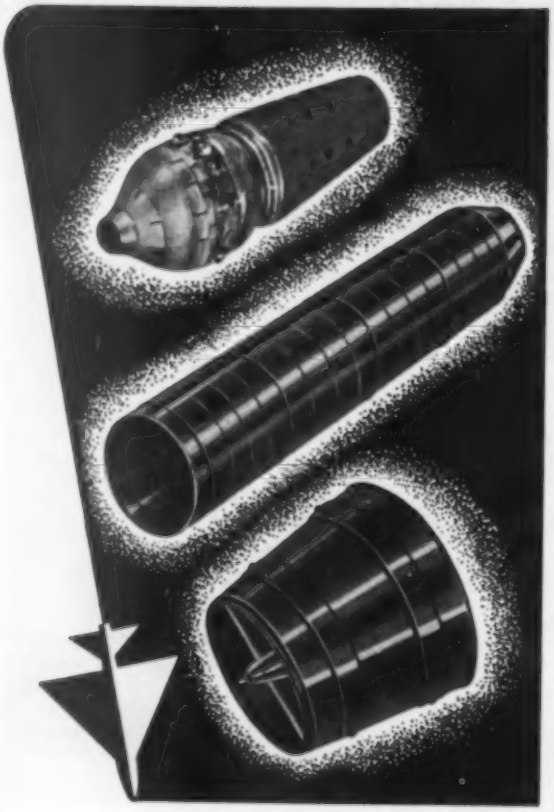
Young men—should they ever again be called up urgently as reserves to defend their country—could learn to fly and service the uncomplicated Seamew quickly. Their burdened elders will readily appreciate this Short answer to the problem of keeping down the cost of defence.

For modern anti-submarine operations—
the *Short* answer is the *Seamew*

Ready For Service With The Royal Navy

Short Brothers & Harland Ltd., Queens Island, Belfast, N. Ireland
The first manufacturers of aircraft in the world; specialists in maritime aircraft since 1910

THINKING OF REPAIRS



then consult

B·A·P

In the course of our production and repair work we offer the services of a fully equipped and efficiently staffed laboratory and design department and assure you of a 100% finished job in workmanship and quality.

BURNLEY AIRCRAFT PRODUCTS LTD
FULLEDGE WORKS, BURNLEY, LANCS., ENGLAND
TELEPHONE 5121/2 and 3203 BURNLEY (5 LINES)
TELEGRAMS—"AIRCRAFT" BURNLEY
REPAIR FACTORY: GROSVENOR ST., STONEYHOLME, BURNLEY. TEL. 5184
ASSOCIATED WITH RENFREW AIRCRAFT AND ENGINEERING CO. LTD., RENFREW, ONTARIO, CANADA

bap4317

A date for the diary of *everyone* in production engineering . . . the most comprehensive show yet seen in this country of the newest, finest, British, European and American machine tools and allied equipment! Study and compare at first hand the world's fastest, most accurate, most economical tools. See them working. Discuss their application to *your* industry, discuss *your* problems with the world's foremost production experts . . . it's Europe's most important engineering event this year. Don't miss it !

INTERNATIONAL MACHINE TOOL EXHIBITION 1956

Olympia · London · June 22—July 6

Exhibition open daily (Sundays excepted) 9.30 a.m. to 6 p.m. Admission 3/6d. Exhibits include machine tools, engineers' small tools, gauges and measuring equipment, testing equipment, presses and power hammers, heat-treatment plant, woodworking machinery.

Organized by The Machine Tool Trades Association, Victoria House, Southampton Row, London, W.C.1.

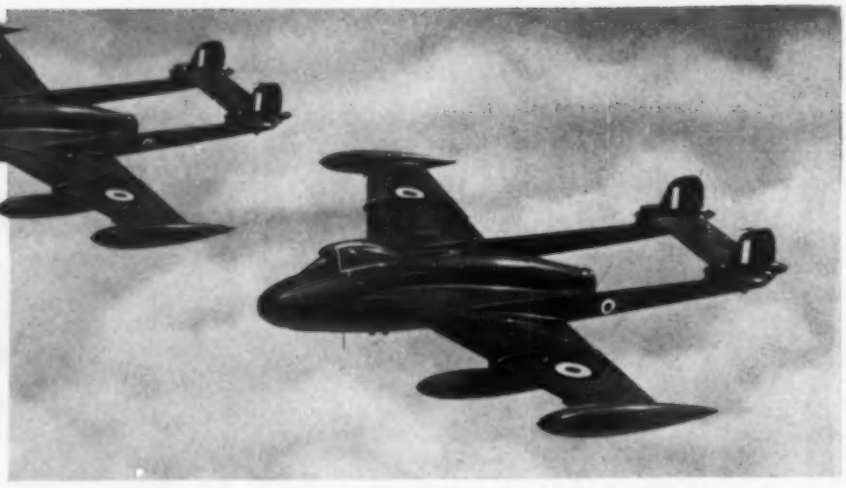
Friendship

THE FIRST VERSATILE TURBOPROP AIRLINER FOR SHORT AND MEDIUM RANGE TRAFFIC ANYWHERE IN THE WORLD, POWERED BY THE WORLD'S MOST RELIABLE PROPELLER-TURBINE, THE FAMOUS 1600 SHP ROLLS-ROYCE "DART"

SAFETY COMFORT ECONOMY

Fokker

WILL SPAN THE WORLD AGAIN!



operational efficiency

VENNER Aircraft Instruments contribute to the reliability and safety of modern aircraft.

VENNER
AIRCRAFT & MARINE INSTRUMENT DIVISION

TDS/H.P. TIME DELAY SWITCHES
for delaying the discharge of the main Methylbromide Bottles until the engine has come to rest and for disconnecting the main batteries within a specified time.

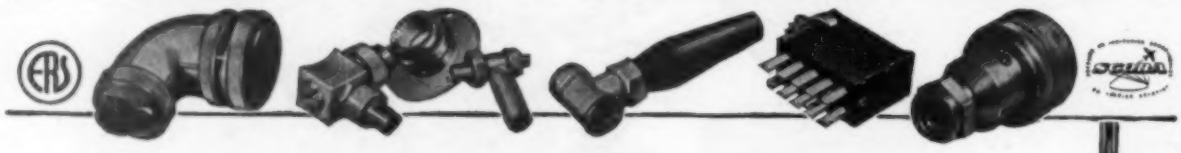
EMERGENCY LIGHTING UNITS
providing automatic illumination in crash or emergency conditions when normal lighting may be rendered inoperative. Designed for flush fitting to cabin wall or roof.

PTC/DH TIME DELAY SWITCHES
fitted to the ignition system of jet aircraft. Switches on high ignition for controlled periods at initial starting on the ground and for relighting in the air.

FOR FULL PARTICULARS PLEASE WRITE TO DEPT. F|V.

VENNER LIMITED, Kingston By-Pass, New Malden, Surrey. MALden 2442.

A member of the Venner Group of Companies, manufacturers of Time Switches · Silver-Zinc Accumulators Process Timers · Aircraft Instruments · Park-O-Meters · Electronic and Electro-Mechanical Instruments.



IN THE AIR AND ON THE GROUND

As actual manufacturers our library records of 69,000 different type connectors made over 15 years for the original M.A.P., M.O.S., Royal Navy, all main Aircraft constructors and various foreign governments

Quick reference can be made to identify and satisfy your exact requirements

ERS LONDON LTD

A.I.D. A.R.B. I.E.M.E. Fully approved

We specialize in the manufacture of

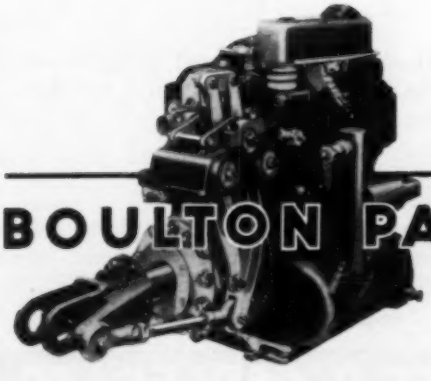
RADIO CONNECTORS

Junction boxes, complete terminations, moulded connectors and inserts, aerial kits, wireless remote control units, insulator and similar assemblies, etc., etc.

Test gear available for testing up to 10,000 volts

E.R.S. Ltd. Brookwood Rd., London, S.W.18 Telephones and Telegrams: PUTNEY 3402/3/4

The high sensitivity of Boulton Paul Power Controls is independent of aerodynamic loads and enables the units to respond to the slightest displacement of the control column under all conditions of flight



BOULTON PAUL AIRCRAFT LTD.

WOLVERHAMPTON, ENGLAND

Designers & Manufacturers of Specialised Aircraft & Ground Equipment

ML

ML AVIATION CO. LTD. WHITE WALTHAM AERODROME, MAIDENHEAD, BERKS.
Tel: LITTLEWICK GREEN 248

1132 MILES PER HOUR!*

RISTS

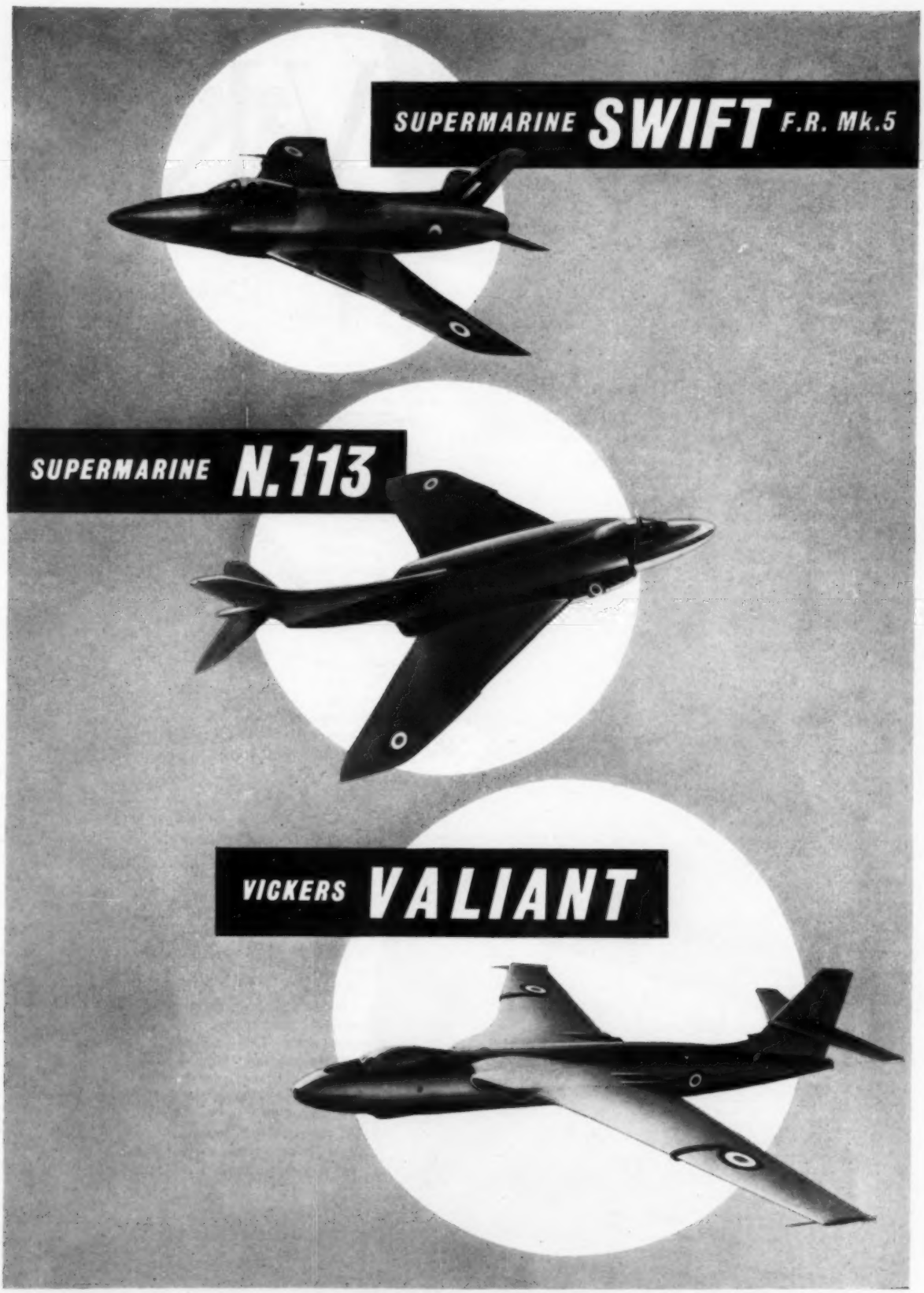
What an achievement! What a tribute to the British Aeroplane and the British Aero Engine.

We are proud that we have made some small contribution to this success.

We are proud of the fact that Messrs. Rolls-Royce Limited have enough confidence in our equipment to install it in their AVON ENGINE.

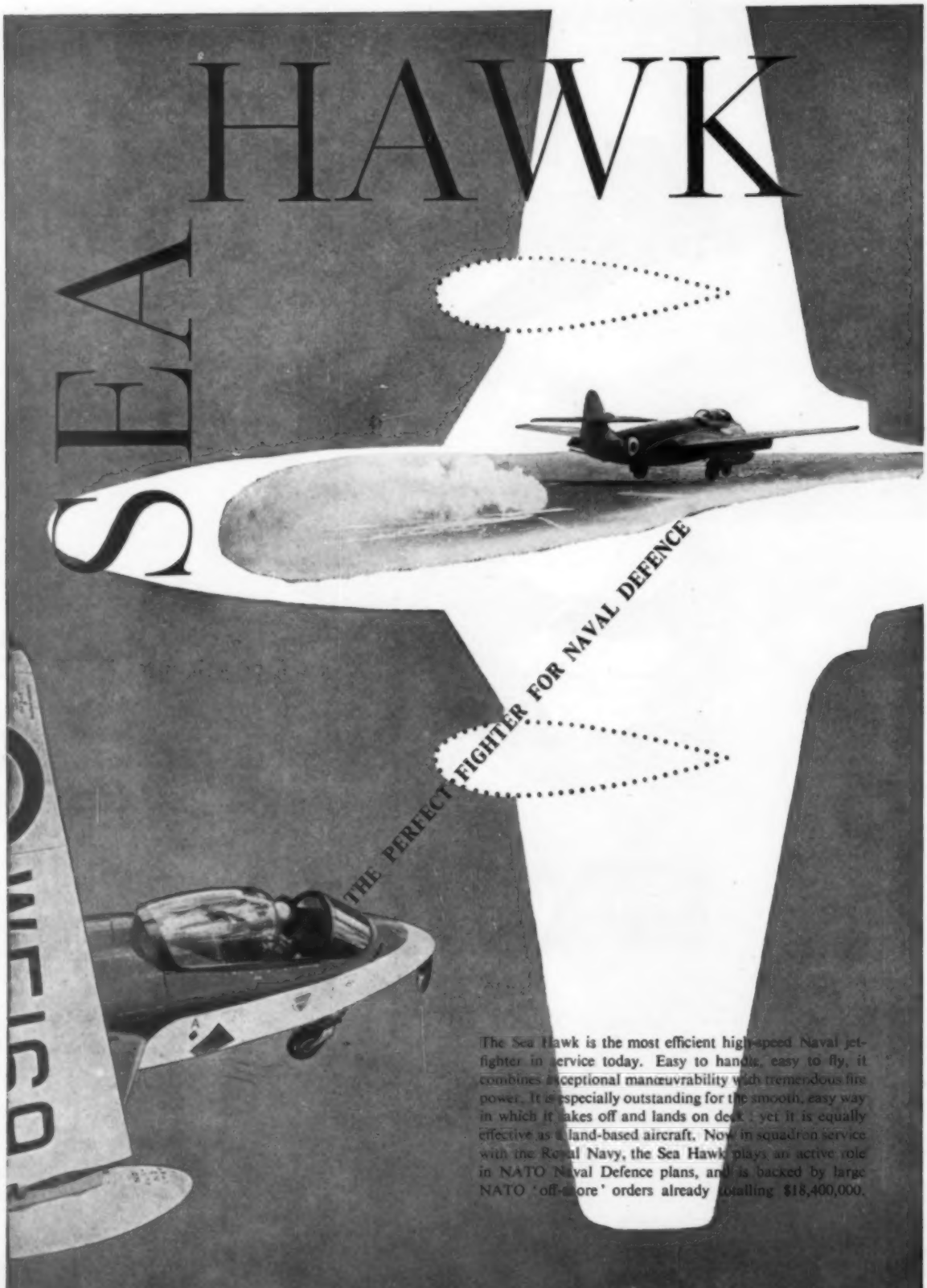
*Subject to official confirmation

RISTS WIRES & CABLES LTD
LOWER MILEHOUSE LANE · NEWCASTLE · STAFFS



VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED - WEYBRIDGE - SURREY

TSA AT444A


SEA HAWK
THE PERFECT FIGHTER FOR NAVAL DEFENCE
The Sea Hawk is the most efficient high-speed Naval jet-fighter in service today. Easy to handle, easy to fly, it combines exceptional manœuvrability with tremendous fire power. It is especially outstanding for the smooth, easy way in which it takes off and lands on deck: yet it is equally effective as a land-based aircraft. Now in squadron service with the Royal Navy, the Sea Hawk plays an active role in NATO Naval Defence plans, and is backed by large NATO 'off-shore' orders already totalling $18,400,000.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD., Baginton, Coventry *Member of the Hawker Siddeley Group/Pioneer . . . and World Leader in Aviation*

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT and AIRCRAFT ENGINEER

No 2472 Vol 69 FRIDAY 8 JUNE 1956

Editor
MAURICE A. SMITH D.F.C. and BAR

Associate Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

Iliffe and Sons Ltd
Dorset House
Stamford Street
London, S.E.1
Telephone · Waterloo 3333 (60 lines)

BRANCH OFFICES

Coventry
8-10 Corporation Street
Telephone · Coventry 5210

Birmingham 2
King Edward House, New Street
Telephone · Midland 7191 (7 lines)

Manchester 3
260 Deansgate
Telephone · Blackfriars 4412 (3 lines)
Deansgate 3595 (2 lines)

Glasgow C.2
26B Renfield Street
Telephone · Central 1265 (2 lines)

Toronto 2, Ontario
74 College Street
Telephone · Walnut 4-5631

New York 6, N.Y.
111 Broadway
Telephone · Digby 9-1197

SUBSCRIPTION RATES
Home and Overseas · Twelve Months, £4 10s. U.S.A. and Canada, $14.00

In this issue

694 News of the Week
696 The Big Noise
698 The Swiss Display
699 Military Aircraft 1956
759 Civil Aviation
760 Correspondence

A Fast Ball

ÆONS before the British air corporations and their independent competitors were thought of, the small birds of the air discovered a way of holding their own against the bigger and more powerful members of the flying fraternity. By combining their diminutive strengths, and with a statesmanlike waiving of individual territorial interests, they could, they found, give the owls and the hawks something to think about. The scheme worked well and may still be observed in action. The sight of bewildered owls being savagely mobbed may arouse sympathy; but they have other plentiful supplies of choice food and are in any case too powerful to suffer permanent harm.

The move among certain British independents to join forces, if it is allowed to develop, presages a radical change in the British civil aviation scene. The idea of a British Independent Airways Corporation is not new; but now more than ever does it seem to offer the only means of removing the word "frustration" which is written across the pages of the British Independent Air Transport Association's yearly reports. The obstacles are immense, and the Government is not likely to make their removal easy, especially now that B.O.A.C. is again a "dependant."

Five weeks ago, as recorded in *Flight* of May 4, the Minister of Transport and Civil Aviation was to be asked in the Commons whether he would give his support to a union of independents. That fast Parliamentary ball was not bowled—presumably because the Minister was at the time preoccupied with the selection of a new B.O.A.C. team; but we hope that, when it is delivered—which we understand will be soon—it will not be stonewalled. A merger of private airline operating interests, and the formidable concentration of negotiating power and capital that could result, might benefit British air transport in general and the manufacturing industry in particular.

Putting It Over

NOW that the season of international air junketings has opened with a sonic salvo at Zurich, we shall do well to look to the form and quality of our national representation on such occasions—especially so in the knowledge that the Tu-104 is likely to drop in almost anywhere with a load of brochures offering 1958 delivery at £425,000 a time. And what a deft move its Zurich visit was, not only in a commercial sense but in furtherance of the Russians' declared good-neighbour policy. How seemly that, instead of throwing yet another flight of screeching fighters into the dogfight for aerobatic prestige (as had been forecast), they should send a peaceful, dignified transport machine. How obliging, too, after intelligence staffs and journalists had spent weeks probing the Russian liner, that details of performance and capacity should be publicly distributed in the most open-handed manner, just as a British naval officer was given the freedom of the cruiser *Ordzhonikidze*.

As a nation we must clearly ensure that our own showing at these important Continental affairs is not only of top quality in terms of material and flying skill, but that it is presented with due imagination. While we do appreciate that it is easier to write in such terms than to invent and perfect a new aerobatic manœuvre, or to wring a prototype from the grandmotherly hug of the Ministry of Supply, we recognize too that the British impact at Zurich was less than could have been wished.

To masses surfeited with jet aerobatics the Tu-104 and the rollicking Czech trainers were refreshing and—the word has a not inappropriate connotation—pacifying.

It is not enough that Britain should merely be represented at these meetings. Her showing must be unsurpassable and, above all, different.

FROM ALL QUARTERS

B.E.A. Viscounts and Helicopters

IN four years—by which time B.E.A.'s traffic is expected to have doubled—the Corporation will have a fleet of 83 Viscounts, assuming that the new options just placed for seven 810s and 12 840s are taken up. This is by far the largest turbine fleet ordered by any airline in the world (the nearest is Capital, with 60 Viscounts, the next PanAm with 44 707s and DC-8s). For the record, the following is a list of B.E.A.'s Viscount orders to date: 26 Viscount 701s (in service from April 1953); 24 Viscount Major 802s, for delivery beginning this autumn; 14 Major 806s, for delivery beginning autumn 1957; seven Major 810s on option for delivery beginning autumn 1958; and 12 Major 840s on option for delivery beginning spring 1959. Delivery of the 20 Vanguards ordered by B.E.A. will begin in the spring of 1960.

Next month B.E.A. will temporarily acquire a prototype Bristol 173 twin-engined helicopter for a brief spell of experimental flying, and it is hoped to follow this up with "extensive development flying" on two later 173s with the larger Leonides Major engines. Hinting at its future helicopter programme the Corporation says: "If all goes well, this programme will lead on to experimental flying by B.E.A. of a prototype Bristol 192C helicopter [a 173 development powered by two Napier Gazelle turbines of 1,650 h.p. with a cruising speed of 138 m.p.h. and seating for 21 passengers] in about three years time."

If progress with this helicopter were promising enough, "a small fleet" might be ordered for operation by 1960.

More Maritime Britannias

FROM Montreal comes news of a further "multi-million-dollar" order from the Federal Department of Defence Production to Canadair, Ltd., for CL-28s—the maritime reconnaissance adaptation of the Bristol Britannia, powered with Wright Turbo-Compounds. As in the case of the original order, no numbers are disclosed.

Russia Vetoes the Viscount

THE proposed flight to Moscow by a party of travel agents and press representatives in a B.E.A. Viscount, which was to have taken place last Wednesday, was cancelled as a result of Russian objections to "specially arranged flights." For the same reason the flight to have been made yesterday by an Eagle Viking with a party of fashion models was called off also.

The Russians' attitude, it appears, is that air travel into Russia should be by regular air routes, and by objecting to special flights they are probably trying to emphasize the fact that their offer to permit regular London-Moscow services has so far not been approved by the British Government.

Javelin Silencer

GROUND running of Gloster Javelin twin-jet all-weather fighters at the company airfield at Hucclecote, near Gloucester, is now taking place in a new silencing pen, which was officially opened on June 1st. In principle the pen is virtually identical with that at South Marston, described in our issue of October 8, 1954; it is, however, considerably larger and cost some £25,000—over twice as much as single-engined installations.

Basic specifications for the Gloster pen were formulated by the late Mr. Quentin Reeves, a consulting engineer who had gained the foremost position in this field and who was tragically killed last year while supervising Hunter 5 running in a pen at Bitteswell. As in his many previous installations the aircraft is backed into a sound-absorbent enclosure and so positioned that the efflux from the two Armstrong Siddeley Sapphires escapes through a 76ft Detuner—one of the first single Detuners to be arranged to accept the output from two turbojets simultaneously. The intake to the Detuner is guarded by wire mesh.

By Comet to Toulouse

THE Comet 3 prototype flew the 564 miles from Hatfield to Toulouse on Saturday, June 2, in 80 minutes, an average speed of 420 m.p.h. The purpose of the flight was to demonstrate the Comet to Mr. J. H. Carmichael, president of Capital Airlines, and his five colleagues (see page 759). The flight was made to Toulouse to enable the party to inspect the Caravelle at Sud-Est's Marignane factory; a flight in the Caravelle was made to Nice and back (during which John Cunningham, who piloted the Comet, handled the aircraft), after which the party returned by Comet to London.

Representatives of B.O.A.C., B.E.A., Trans-Australian Airlines, Rolls-Royce and the Ministry of Supply were on board the Comet with the party from Capital Airlines.

Vickers' New Chairman

TWO days before his retirement, on May 31, from the chairmanship of Vickers, Ltd., Lt-Gen. Sir Ronald Weeks, K.C.B., C.B.E., D.S.O., M.C., T.D., had the satisfaction of being able to tell shareholders, in his last annual address, that "The Vickers Aircraft stable can count its wins with Valiant production dead on schedule, Viscount production only slightly behind on its scheduled deliveries, Swifts coming out on time on the rearranged programme and the N.113 developing according to plan." (This story of progress is underlined by the accounts, which, broken down into figures for the shipbuilding, aircraft, steel and general engineering divisions, show that aircraft business accounted for 31.5 per cent of the total 1955 turnover of £131m; in 1954 the proportion was only 20 per cent.)

Viscount Knollys.

Sir Ronald—whose inclusion in the Birthday Honours is referred to on the opposite page—is succeeded by Viscount Knollys, G.C.M.G., M.B.E., D.F.C., who has been a director of the company since 1952 and deputy chairman since 1945. He served in the R.A.F. during the First World War, and from 1943 to 1947 he was chairman of B.O.A.C. He is chairman of the R.A.F. Benevolent Fund.

Appointment of two special directors of Vickers-Armstrongs (Aircraft), Ltd., was announced last week. They are Mr. J. E. Armitage, F.C.W.A. (commercial manager, Weybridge works), and Mr. N. Sims (commercial manager, Supermarine works).

R.A.F.A. Conference

LAST week-end, the Royal Air Forces Association held its annual conference, this time at Southport, where 364 branches were represented.

In the chair was Marshal of the Royal Air Force Lord Tedder, who, in succession to the Duke of Edinburgh, was invited to become president of the Association for the next three years. The

DECIBEL DOUSER: As described in a news-item above, the Gloster Aircraft company have commissioned this sound-absorbent ground-running pen for Javelins now flowing from Hucclecote. An F.A.W.4 is in position; the entrance doors are closed before running.

IMPLEMENTATION: Seen on its first dropping trials is the prototype Auster Agricola. A number of runs were made across Rearsby airfield with the hopper doors at various settings. Pelleted superphosphate was used and the trials were described as "entirely successful."

Hon. Treasurer, A. Cdre. J. Swire-Griffiths, reported the Welfare Fund to be "fairly prosperous," last year's Wings Day having contributed £55,697 and the collections at cinemas where the *Dam Busters* film was shown, £23,451. Further details of the conference will be given next week.

F.D.2 Record Confirmed

THE F.A.I. has confirmed the world air speed record set up on March 10 by Peter Twiss in the Fairey Delta 2 (Rolls-Royce Avon) at 1,822 km/hr (1,132 m.p.h.).

Vulcans to Enter Service

THE first Avro Vulcan bombers are about to go into R.A.F. service at Waddington, Lincs. The station has been reconstructed for a training unit which, on lines similar to the Valiant training station at Gaydon, will produce the crews for the operational squadrons. Waddington is commanded by G/C. P. Connolly.

Johannesburg Races Off

THE Johannesburg Festival Air Races, which were to have been held next September over courses from the United States and the United Kingdom to Johannesburg, are not to take place. The Aero Club of South Africa has informed the Royal Aero Club that the Festival management committee is unable to guarantee the prize money, which was to have totalled £75,000.

Cranfield Anniversary

AS part of the celebrations of the tenth anniversary of the College of Aeronautics, Cranfield, a public Open Day is to be held at the college tomorrow, Saturday, June 9. Visitors will be able to inspect the various departmental facilities from 10 a.m. until 6 p.m., and it is possible that demonstrations will include the operation of wind tunnels, ramjets and rocket motors.

To mark this anniversary occasion, next week's issue of *Flight* will include two special feature articles.

Engines in the News

PROGRESS reports on various lines of engine development include the following: de Havilland are installing a second Gyron in the Sperrin flying test-bed; when Valiants are fitted with D.H. Super Sprites they will have one of these take-off rocket motors under each wing; the Napier Eland NEl.1 has passed its type-test; the Bristol Proteus 755s now being tested in the Britannia 100 are in the outboard nacelles; an Orpheus is to be test-bedded in the Avro Ashton; two Rolls-Royce Dart RDa.7s, developing 1,800 s.h.p. each, are ready to be flown in a Dakota; and an R-R. Tyne/Elizabethan conversion is in hand.

The Birthday Honours

SEVERAL members of the aircraft industry are named in the Queen's Birthday Honours, announced last week. They include Lt-Gen. Sir Ronald Weeks, who has just retired from the chairmanship of Vickers, Ltd., and upon whom is being conferred a barony, and Mr. G. H. Dowty (chairman of the Dowty Group), who is to be knighted: he is cited in the list as chairman of a disablement advisory committee, this signifying a cause in which he has given much valuable service.

Appointed K.B.E. is Capt. I. N. Holyman, managing director of Australian National Airways, and one of the founders of the airline's predecessor; Saunders-Roe's managing director, Capt. E. D. Clark, is appointed C.B.E.; and especially worthy of note among technical executives in the list is the name of Mr. L. H. Bedford (C.B.E.), chief engineer of the English Electric guided weapons division. Too seldom do names of test pilots appear in the Honours, so it is gratifying to see included Mr. J. H. Orrell (O.B.E.), who recently retired as Avro chief test pilot.

Given below are names noted in the first sections of the civil Honours; M.B.E.s and other appointments we shall list in our next issue. Also published next week will be the names of recipients of Honours in the military lists; among these are Air Marshals R. B. Jordan and T. N. McEvoy, who are respectively A.O.C-in-C. Maintenance Command and Chief of Staff A.A.F.C.E.; both are being made K.C.B. Appointed K.B.E. are Air Marshal R. L. R. Atcherley, A.O.C-in-C. Flying Training Command; Air Marshal G. E. Nicholetts, A.O.C. Malta; and A.V-M. J. R. Whitley, A.O.C. No. 1 (Bomber) Group.

THE SIXTH MARK of the Hawker Hunter, a production example of which is seen, is now going into squadron service with the R.A.F.

Baron.—Lt-Gen. Sir Ronald Weeks, chairman, Vickers, Ltd.

Privy Councillor.—A. H. E. Molson, M.P., Joint Parliamentary Secretary, Ministry of Transport and Civil Aviation, since 1953.

Knights Bachelor.—W. F. Beale, chairman, board of management, N.A.A.F.I.; G. H. Dowty, chairman, Cheltenham and North Gloucestershire Disablement Advisory Committee; Prof. W. J. Pugh, director, Geological Survey of Great Britain and Museum of Practical Geology.

Order of the Bath.—*C.B.*: J. Anderson, chief scientist, Admiralty Signals and Radar Establishment, Portsdown; L. H. Curzon, Under-Secretary, Ministry of Supply; Col. A. Halkyard, chairman, Leicester and Rutland Territorial and Auxiliary Forces Association; J. E. Keel, Under-Secretary, M.T.C.A.; G/C. M. Robinson, chairman, Glasgow Territorial and Auxiliary Forces Association.

Order of St. Michael and St. George.—*K.C.M.G.*: A. Cdre. J. A. Easton, R.A.F. (Ret.), for official services. *C.M.G.*: D. H. Black, chief scientific officer, M.o.S.; R. O. Wilberforce, Q.C., senior legal adviser and British delegate to I.C.A.O.

Order of the British Empire.—*K.B.E.*: I. N. Holyman, managing director, Australian National Airways; V. H. Raby, Deputy Under-Secretary of State, Air Ministry. *C.B.E.*: L. H. Bedford, chief engineer, guided weapons division, English Electric Co., Ltd.; L. Boddington, deputy chief scientific officer, M.o.S.; Capt. E. D. Clark, managing director, Saunders-Roe, Ltd.; R. M. Currie, head of work study department, I.C.I., Ltd.; E. W. Hicks, Secretary, Australian Department of Air; A. W. Isherwood, Director of Contracts (air), M.o.S.; C. H. McKay (for services to Victorian branch of the Returned Sailors', Soldiers' and Airmen's Imperial League of Australia); S. P. Peters, Deputy Director (Forecasting), Meteorological Office; Capt. M. Sorsbie, lately general manager, East African Airways Corporation; C. Sykes, managing director, Thomas Firth and John Brown, Ltd.; A. B. Watts, director of British Ropes (Southern Sales), Ltd.

O.B.E.: F. Belcher, dep. dir., supplementary ground services (civil aviation), M.T.C.A.; R. W. McG. Boswell, of Salisbury, S. Australia, for outstanding public services in the guided weapons field; L. E. Caygill, Assistant Director, Civil Aircraft Research and Development, M.o.S.; J. D. Douglas, operations planning manager, B.O.A.C.; A. F. Fitness, principal, Air Min.; H. Frost, chief executive officer, Air Min.; Lt-Col. R. G. G. Harvey, secretary, Londonderry, Tyrone and Fermanagh Territorial and Auxiliary Forces Association; C. Heyes, superintendent mechanical and electrical engineer grade 1, Air Min.; A. R. Jackson, chairman, Manchester Wing committee, Air Training Corps; M. L. Jofeh, deputy chief engineer, Sperry Gyroscope Co., Ltd.; A. H. Layhe, manager (purchasing), British Insulated Callenders Cables, Ltd.; Col. A. J. Masterson, for services as secretary, County of Warwick Territorial and Auxiliary Forces Association; J. H. Orrell, lately chief test pilot, A. V. Roe and Co., Ltd.; S. Partington, internal head of works, Salford Electrical Instruments, Ltd.; H. G. Sturgeon, chief engineer, Ultra Electric, Ltd.; J. R. Vezey, prin. scientific officer, Coastal Cmd.

IN THE HONOURS LIST, names from which are quoted above, are the following (left to right): Sir Ronald Weeks (Baron), Mr. A. H. E. Molson (P.C.), Mr. G. H. Dowty (Kt. Bachelor), Capt. I. N. Holyman (K.B.E.), Capt. E. D. Clark (C.B.E.), and Mr. L. H. Bedford (C.B.E.).

THE BIG NOISE

F-100Cs in Service with the U.S.A.F. in Germany

"Flight" photograph

A pair of F-100Cs "blasts off." They intercepted some F-86s at 32,000ft four minutes later.

THE 36th Fighter Day Wing, based at Bitburg, Germany, and commanded by Col. John A. Brooks, has been re-equipped with the North American F-100C Super Sabre. As first pilot in the Wing, Col. Brooks was first to go down to Sidi Slimane in North Africa to fly the new aircraft with the 45th Fighter Day Wing. All pilots complete the initial ten hours of the conversion with this unit and then fly their machines back to Bitburg. The 36th Wing has three F-100C squadrons, the 22nd, 23rd and 53rd.

Although the F-100C has atomic capability the Wing has no special-weapons task. Its job in war would be to achieve air superiority where and when a combat situation might require it—by intercepting enemy aircraft, by straffing them on the ground, by mounting a diversionary air attack, or by drawing off enemy intercepters from the main attack. Air superiority requires the support, in any feasible way, of a striking force which may be composed of Tactical Air Command fighter bombers or Strategic Air Command long-range bombers.

Despite a tremendous load-carrying capacity for either weapons or extra fuel the F-100C is regarded at Bitburg as a fighter in the same way as the F-86F it supersedes. But the F-100 normally operates at supersonic speeds and therefore leaves shock-waves and booms about the place. The Americans are anxious to convince the public that, however noisy these phenomena may be, they cause no damage. The civilian population must, they say, learn to live with the noise of engines and shock-waves as a reasonable sacrifice in the interests of peace and security. Nevertheless, the first F-100 pilot to arrive is reported to have made a very-high-speed pass over the base, smashing $30,000 worth of windows and radar tubes. Extreme care is now taken to avoid such feats in peaceful areas, but shocks could in wartime be used for such varied tasks as damaging enemy aircraft on the ground; making housing unusable in very cold weather by breaking all the windows; rubbing out vehicle tracks in loose earth; or simply for smashing delicate technical equipment. The F-100C will make a good boom below the speed of sound if the air-brakes are extended at Mach 0.9.

Though the aircraft looks formidable, particularly on the ground, the only qualification required for F-100 flying is 50 hours' swept-wing time, and some F-100 pilots in the 36th Wing have as little as 500 hours' total flying time. But they really like the new fighter. They say it is more pleasant to fly than the F-86, is easier in formation, is stable on instruments and has the makings of a very fine formation-aerobatics mount. Above all, it has tremendous performance. Level supersonic flight takes a little getting used to, but there is no sign on the controls when going past Mach 1.0—just a jump by the Mach-meter needle from about 0.95 to over unity. Highest speeds are in the region of Mach 1.6 and sonic speed can be maintained throughout any normal tactical manœuvre, though it cannot apparently be achieved on the level below 6,000ft.

A cut-away drawing and description of the F-100A which appeared in *Flight* on May 20, 1955, applies in almost all respects to the F-100C and can be referred to with this account.

At low speeds the F-100 is reported to handle well and it can use the same standard runway as the F-86. It can take off, carrying some external stores, without reheat and can land in 2,000 yd without using the drag parachute. For tactical purposes, however, and to save tyre and brake wear, the afterburner is nearly always used for take-off and the drag parachute for landing. Acceleration on take-off is terrific and 100 kt is achieved in 700 to 900 yd with afterburner, although the aircraft is not flown off for about 1,800 yd. Stalling speed is about 130 kt, and the normal curved fighter approach can be used, with a final approach speed of 190 kt and touch-down at 155 kt. The angle of attack over the hedge is pronounced but not exaggerated at this speed and the pilots seemed able to adjust their final rate of descent accurately and easily with engine power. Throttle response is apparently instantaneous.

Without flaps, and facing the possibility of scraping the tail-bumper if the nose is held up after touch-down the pilots get aerodynamic drag by extending the great barn-door airbrake under the fuselage and by using the drag parachute. Wheel brakes are of the multi-pad disc type with Hytrol anti-skid units. The small-tyred nose diabolo is steered by offsetting the centre position of the hydraulic shimmy-damper through a cable and pulley run connected to the rudder bar. Nosewheel steering is selected, as on the F-86, by pressing a button on the control-column grip; but the F-100's steering is better than that of the 86 and can be used throughout take-off and landing. A set of tyres lasts about 20 landings.

For most sorties pilots wear standard U.S.A.F. equipment. The ejector seat is fired from triggers on the armrest and the pilot is automatically released from his seat after three seconds, whereupon the barostat in his parachute pack will ensure free fall down to 15,000ft before the rip-cord is pulled by a spring. The parachute itself is new in that it uses the bagged-canopy principle developed by G.Q., Ltd., some years ago. Half the canopy is packed in a sleeve, thus avoiding explosive opening.

The Pratt and Whitney J57 is started by pressure air supplied by a small turbine on a starter truck and blown across the compressor blades. The starting sequence is slow, and it appears to require two or three men besides the pilot. The trolley turbine is revved up as soon as the canvas hose is connected to the aircraft, *via* an adaptor, just aft of the port main-wheel bay. A mechanic standing on the wing root signals with his fingers the r.p.m. attained by the engine until, at self-sustaining r.p.m. of about 4,000, everything is disconnected and hatches closed and checked. While taxying the engine is very quiet, though the nodding of the nose during braking and the slightly hump-backed appearance of the aircraft give it a threatening and wicked air. At 100 per cent power it becomes fairly noisy, but afterburning causes an astounding outburst of sound. Standing still with brakes on and the engine giving 100 per cent r.p.m. the nosewheel tyres are practically flat and the afterburner cannot be held on the brakes at all. Its power gain can be varied over 50 per cent with the power lever so that formation take-off and close formation can be maintained with the a.b. (as the Americans call it) cut in. At 92 per cent power or higher the pilot can apply a 9lb outward force on the power lever and the a.b. will erupt into action within two seconds. To avoid accidental cut-out a pull-force of 18 lb is needed to disengage the afterburner.

The F-100C's afterburner is without any doubt one of the noisiest things in aviation. When the pilot "kicks-in his a.b." the multi-leaf eyelids can be seen to snap into the wide-open setting. About one second later there is a thunderous explosion inside the tail, and a ten-foot stream of orange flame heavily laced with shock-wave patterns. The point of most intense noise is at 45 deg to the aircraft centre-line where, at 50 yards' range, the ears become unbearably painful and the sound plays on one's diaphragm like water from a fire-hose. With F-100s passing overhead, kicking-in the a.b. makes a report like a cannon shot.

Although U.S. Air Force security allows no more to be said about the J57 than that it is in the 10,000lb-thrust class, its actual thrust can reasonably be supposed to be somewhat higher, and the afterburner gives an increase of 50 per cent on the total. Thus it was that at Bitburg two F-100s gave four F-86Fs 15 minutes' start and then intercepted them at 32,000ft under G.C.I. control in four minutes from wheels rolling. During such a climb the F-100C uses four times as much fuel as an F-86F. At 35,000ft to 40,000ft the specific of the J57 with afterburner is 1.8 lb/hr/lb/thr. For a normal range-cruise the afterburner is not used and a Mach number of 0.85 to 0.86 is maintained at 35,000ft to 45,000ft. The F-100 carries 1,195 U.S. gallons of JP-4 internally and those that were ferried across the Atlantic for the 36th Wing carried two U.S. 275 gal wing tanks for the crossing. They travelled *via* Goose Bay to Keflavik and from Keflavik direct to Bitburg. With a tail-wind from Keflavik one pilot even contemplated flying direct to Sidi Slimane. The flight back to Bitburg takes just over two hours.

The slats on the F-100's wing leading-edge are exactly the same in layout and function as on the F-86E and D. They open at low speeds and at high angles of attack at high speeds and give an excellent stabilizing effect in such conditions as approach

3 engines of increasing importance to helicopter operators

ELAND Fairey's new large transport helicopter, the Rotodyne, is to be powered by two *Elands*—basically similar to the standard *Eland* but with an auxiliary compressor mounted co-axially at the rear. Power is taken through the auxiliary compressor (in the form of compressed air to the rotor) for vertical flight, and through the propeller for forward flight.

ORYX Two Napier *Oryx* engines have been mounted in the new Percival P74. Napier worked with Hunting Percival in the development of the *Oryx*, a 780-825 gas h.p. turbo-gas-generator which has been officially Type Tested at 780 g.h.p. This new Napier power unit eliminates all mechanical transmission.

GAZELLE This 1,260 s.h.p. Free Turbine helicopter engine is another Napier engine which is going places. Two *Gazelles* will be mounted vertically in the Bristol 192, a new twin rotor helicopter, and one *Gazelle* will power the Westland "Wessex" helicopter which is being adopted by the Royal Navy. The engines are directly connected to the rotor heads, providing mechanical transmission in its simplest form.

Designers and Manufacturers of Rocket Engines and Ramjets

NAPIER MORE POWER AT LOWER COST

D. NAPIER AND SON LIMITED · LONDON · W.3.

CBC 825

Lightweight Sub-Miniature ADF

TYPE AD 722

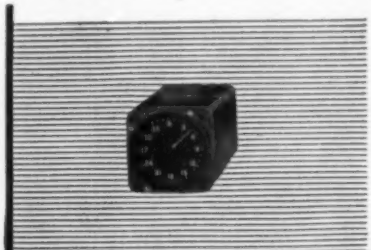
Designed to the most stringent specifications, the Marconi type AD 722 ADF is particularly suitable for high speed, high altitude aircraft.

Special features are :—

- Weight less than 22 lbs.
- Employs fixed, crossed loop aerials in a flat streamlined housing.
- Frequency coverage 200-1700 kc/s (in 3 bands).
- Operation entirely from 28Vdc primary aircraft supply without use of rotary transformers or vibrators.
- Ease of maintenance through sub-unit construction.
- Provides visual relative bearing indication with simultaneous aural reception.

The receiver remote control unit.

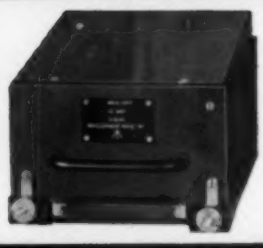
The compact loop aerial which is mounted on the aircraft fuselage.



The bearing indicator unit which embodies the goniometer.

The RF amplifier unit complete with mounting assembly.

The quadrantal error corrector unit.



The IF/LF amplifier unit complete with mounting assembly.

More than forty Air Lines and twenty Air Forces fit Marconi air radio equipment. Marconi airport installations are in use throughout the world.

Lifeline of communication

MARCONI

Airport and Aircraft Radio Systems

MARCONI'S WIRELESS TELEGRAPH CO. LTD., CHELMSFORD, ESSEX

LA 19

THE BIG NOISE . . .

and landing. The air-brake, large though it is, can be used at all speeds above and below Mach 1. It produces no trim change and little buffet, but very good deceleration. Use of air-brake does not upset gunsight tracking.

Next month the 36th Wing is due to start air-to-air firing by F-100s at a banner towed by a F-86 at 28,000ft. The F-100s will be in position ready to start the attack at Mach 0.85 and will accelerate to beyond Mach 1 by the time they reach the firing position. Time taken to move from maximum firing range to minimum permissible range is something like eight-tenths of a second. The normal A-4 radar-ranging gyro gun-sight is used.

The only performance limitation on the F-100C at Bitburg seems to be in the maximum rate of roll. Pilots are not allowed to apply more than two-thirds lateral stick travel, or 200 deg/sec. So long as the F-100 rolls precisely about its fore-and-aft axis there is no difficulty, but if the axis of the roll shifts a dangerously divergent (and disastrous) barrelling effect may arise.

The F-100 pilots are tigers all. Ask them about collision course or atomic bombs and they reply that they "just go in and clobber enemy aircraft." They have had dog-fights with Canadian Sabre 6s, Sabre 5s, R.A.F. Hunters and Meteors and they delight in their speed advantage over all of them. The Meteor is comparatively so slow, and can turn so tightly, that the F-100 rarely gets time to fire at it before it disappears astern; the best stratagem for the F-100 is to stand off a few miles and then charge. The Sabre 6 gives quite a lot of trouble, both because of its great power and its good turning circle; but the F-100 can usually manœuvre to a good hitting position by using its tremendous power and speed capabilities. As for vertical-plane capability, it can out-yo-yo the Sabre. The Hunter, too, gives the F-100 a good deal of trouble. The pilots particularly remarked on a very tight turn.

A Hamilton Standard fuel/air starter will later make the F-100 independent of trolleys for starting. It relies on hydraulics for both powered controls and services. The mainwheel tyres are 30 × 8.8in, Type VII, 18-ply nylon.

The flying controls are, of course, fully hydraulically powered and irreversible. The actuators for the ailerons lie just ahead of the hinge line at the inboard section of the aileron. This surface is hinged at the top skin and actuated at the lower edge. Control rods from the cockpit are led along the leading edge and back through the wing torsion-box. Total thickness of the tail slab towards the tip is of the order of 1in to 1.5in; and the root of it is considerably thickened to accommodate the massive pivot fitting. The gap between slab and fuselage is roughly filled by canvas beading, heavily greased. The tail-slab actuator lies on the fuselage centre line, below the afterburner and between the rear-fuselage fuel tanks. The whole of this part of the tail is liberally provided with cooling air ducts and double skins.

The fin is anchored to the tail section by an extremely large machined fork fitting picking up the central fin structure with six very large bolts. On each side of this pick-up structure, in the slightly swollen fin-root, are the hydraulic actuator and the bungee feel device for the rudder. This equipment is new in the F-100C. Both horizontal-stabilizer and rudder controls are fitted with gyro stabilizers which can be switched on or off from the cockpit. Pilots seem to use them mainly for firing and ciné-camera work, and not all the time. At high speed pilots can watch the thin fin flexing in their rear-view mirror.

One of the most remarkable features of the F-100C is the accessibility of its equipment, which never seems to be more than a few inches below the surface. The after fuselage can be detached complete, and when the enormous engine, too, is unshipped the airframe has lost its core. Everything is left in the shallow band of structure remaining about the cavernous "engine room." The whole of the spine fairing is detachable, uncovering fuel vent-pipes, rudder-control lines, co-axial aerial leads and aerial, electrical cable and that excellent stand-by, the emergency air-turbine motor which is extended into the airstream by hydraulic jacks if engine r.p.m. fall below flight-idling setting with the undercarriage up. It drives a stand-by generator which will maintain services in case of flame-out or accessory failure. The automatic extension device has a mechanical stand-by.

On the side of the fuselage, level with the cockpit, a painted notice identifies the access panel to the "A-2 control-surface computor" whose work is connected with providing the q-feel or with gunfire- or bombing-control. The only dynamic-pressure sensing point on the F-100 appears to be in the long, flexible pitot boom projecting from under the intake. The dynamic-pressure sensing intake is recessed inside a sharp-lipped orifice at the head of the boom and is in the form of a very small annular intake disposed about a tiny bullet. Static sensing holes are on the outside of the tube. The boom can be "broken" and swung up to the almost vertical position for parking.

The major part of the nose top-decking astride and forward of the windscreen swings up like a car's bonnet to reveal the central radio and radar equipment bay. This accommodates the radar transponder beacon; U.H.F. radio; A.D.F. equipment and power supply; and a "data case" on the inside of the decking to hold the necessary documents for this equipment. A rake of tubes outside the windscreen supplies either de-icing liquid or supersonic air as a rain repellant. Pilots report that visibility from the cockpit is good and that the nose decking is not visible from inside. Rearwards they can see round to the outer section of the slab tail, and a mirror gives a clear view past the fin.

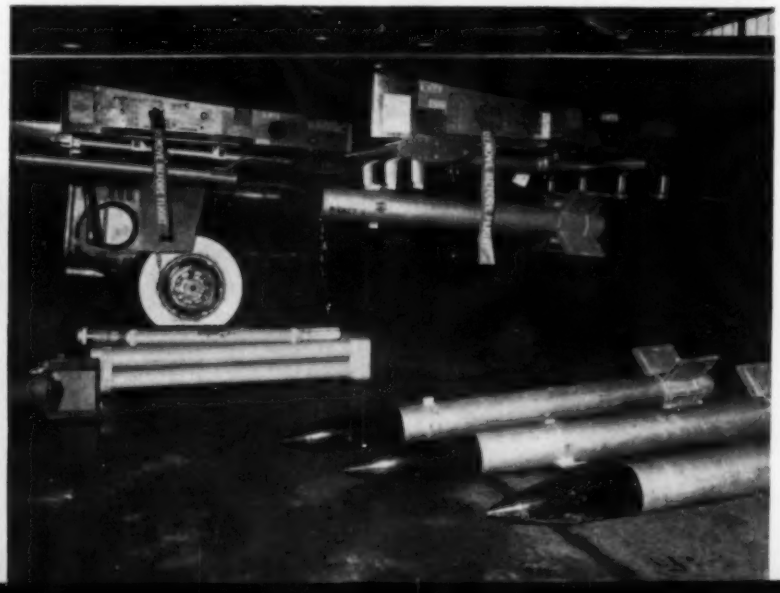
The aircraft can taxi with slotted drag parachute deployed, but it is normally jettisoned at the end of the runway. For safety reasons, the parachute is set to break away at 180 kt.

The F-100C has special-weapons capability and can carry a very large load on six under-wing pylons. Standard are four M-39 revolver cannon working on the principle of the MG-213C. Combined rate of fire is 6,000 rounds/min. The guns are mounted almost upside-down under the roof of the gun bays, which are ventilated by plain slots in the outer skin. A chamber immediately behind the gun bay and below the wing leading-edge is suitably padded to collect ammunition links. The cases are ejected rearwards along tubes which pass through the link chamber and vent at flush orifices under the fuselage. The barrels of the guns are housed internally within the blast tubes, and each has one steady mounting. Some 200 rounds per gun are carried in four tanks placed aft of the ejector seat.

At Bitburg a wide variety of stores and weapon-carrying attachments was displayed on an F-100C fitted up with three pylons under one wing. Round it was laid out a selection of bombs from 2,000 lb to 500 lb, 5in 60 lb H.V.A.R. air-to-ground rockets and 2.75in folding-fin Mighty Mouse air-to-air rockets. One pylon carried two streamlined cross beams to hold three H.V.A.R. rockets with interleaved fins on zero-length attachments. The load-carrying pylons themselves are complex affairs because, in an extremely thin section, they accommodate fuel lines, firing cables and MA-3 explosive jettisonning gear. C.M.L.

The skin-tight T.1 partial pressure suit (left) is worn on all trips above 50,000ft. The g-suit is integral and the face-piece electrically heated. The F-100C's complicated pylons (right) carry Mighty Mice, H.V.A.R. rockets, napalm, bombs or tanks.

"Flight" photographs



Somewhat similar in appearance are the Mystère IVAs of the Patrouille de France (above left) and the F-100Cs (right), seen streaking past a "box" of F-86Fs. Maj. A. K. Starikov (below, left), Russian Tu-104 pilot, calm again after his aircraft had been assailed by onlookers. (Below, right) Switzerland's own beam-riding, ground-to-air missile, the Oerlikon/Contraves, several of which were on exhibition.

THE SWISS DISPLAY

THE bigger the air show the more does the onlooker become satiated with spectacle, and, consequently, uncritical of the technical performances. Noise comes to mean more than skill, and at each new display it is the spectacular which attracts more attention than the first-class performance with a well-known aircraft. Particularly was this so at Zürich.

For sheer achievement, however, the three Zlin Treners definitely stole the show, as the Czech aerobatic pilots so often do. They never left their vic formation, but they were rarely all the same way up. They rolled off the top individually in vic; the two outside men rolled upside down without leaving formation; the three then looped before the leader joined the others in the inverted position; the vic, inverted, made a 180 deg turn and a complete upward outside loop. This went on for several staggering minutes until we almost forgot which way up they had started.

Indicative of American efforts to replace manpower with really powerful weapons in NATO were the four guided missiles shown by them at Zürich. All four are in operational service in Germany—Nike, ground-to-air; Honest John, ground-to-ground ballistic, solid fuel; Matador, ground-to-ground jet-propelled pilotless bomber; and Corporal, a liquid-fuel, programmed-control rocket weapon of considerable range developed broadly from the German wartime V-2. This last-named weapon was shown together with its transporter/erector vehicle, launching platform and mobile servicing platform, but without any of its guidance and programming computers. It belonged to the 531st Field Artillery Missile Battalion, U.S. Army, which operates two firing sections and an H.Q. and Servicing battery. The missile is 45ft long and weighs several tons. It is steered by control surfaces on the fins and by graphite vanes in the rocket stream. Each fin is marked "N," "S," "E" or "W" to allow correct orientation relative to the target. The 531st has fired four Corporals at White Sands, New Mexico, two of them, nicknamed *Keeling's Wonder* and *Bitch*, from the platform shown at Zürich. Corporals are expensive.

"Flight" photographs

Part of America's strong missile contribution. The Matador and Honest John seen at left, were accompanied by Nike and Corporal. (Below, left) a Hiller helicopter brought the traditional clown "Globi" to see the children. Grown-ups were treated to a gay napalm explosion (below), which was well followed up with 20 mm shells from Venoms.

F A I R E Y

ACHIEVEMENT

In operation

The Fairey Gannet has proved in service to be the world's most successful anti-submarine aircraft, combining the ability at once to search and to strike decisively with newly-developed weapons.

In production

The Fairey Gannet was one of the first of the super-priority aircraft in service. Rapid production, complete interchangeability, no time-lag between prototype and production—these are the advantages of Envelope Tooling, a revolutionary method of assembly invented, designed and developed by Fairey.

THE FAIREY AVIATION COMPANY LIMITED

ENGLAND · AUSTRALIA · CANADA

D

In Service with the Royal Air Force

The ability to complete pilot training to "Wings" standard on the minimum number of aircraft types is an ideal at which all Air Forces aim. The JET PROVOST has demonstrated that with a maximum level speed of more than 280 knots, a ceiling of 35,000 ft., a retractable nosewheel undercarriage, air brakes and a turbo jet engine, it is ideally suited to ab initio training in addition to leading into the advanced trainer . . . so enabling the two-stage training ideal to be maintained for many years to come. Furthermore, the need for jet conversion training on the expensive Advanced Jet Trainer no longer arises.

JET Provost

Powered by one Armstrong Siddeley Viper Turbo-Jet

HUNTING PERCIVAL AIRCRAFT LTD

A Hunting Group Company

LUTON, BEDFORDSHIRE, ENGLAND and at 1450 O'CONNOR DRIVE, TORONTO, CANADA

MILITARY AIRCRAFT

1956

BY THE ASSOCIATE EDITOR

STRONGLY *apparent from these sixty pages are the increasing extent and diversity of effort in fighter development. Bombers, by comparison, are few—by reason of their astronomical cost of development and operation, and doubtless in the realization that certain of their tasks can be undertaken more economically and with higher hopes of success by adapted fighters. Never was there a time when the raider was developing so closely along the lines of the defender. The more significant military aircraft in service, under development or construction, or merely in prospect, have been given pride of place in this supplement, which is in no sense an inventory or order of battle. A number of lesser types, some surviving, others supplanted, have been omitted in order that the newer and more important developments may receive full acknowledgment. Thus, what is primarily a review of present-day practice serves also as a pointer to the future.*

MILITARY

AIRCRAFT

1956

FIGHTERS

de Havilland Venom F.B.4.

IN fighter development today only scant traces of pattern are discernible. It appears instead as a jigsaw, comprising a multitude of machines designed or adapted for diverse purposes, of almost every shape, and of many sizes. Though technical characteristics have to some extent been dictated by operational necessity, influences both of fashion and fancy are perceptible. As for the long-prophesied trend towards specialization, we need only remark that the Lockheed Starfighter, now sharing the limelight with English Electric's P.1, can be a single- or two-seat fighter or trainer; a bomber—even an atomic bomber; it can be used for reconnaissance; or it can even oblige in the low-level attack rôle. Not so the coming generation of mixed-power interceptors, typified by the Saunders-Roe S.R.53, Dassault Mirage, Nord Griffon and S.E. Durandal, for their tactical employment is restricted by their inherently short endurance. Pure-rocket "target-defence" machines, after the German pattern, have not survived.

In classifying the many and various types of fighter deemed worthy of inclusion here, the writer saw no justification for departing from the system adopted in his former review (June 1954). Thus, we have single-seat land-based; single-seat ship-based; single-seat water-based; multi-seat land-based; and multi-seat carrier-based machines.

It will be seen that the single-seat day fighter continues in production as an interceptor and air-superiority weapon, though the demand for all-weather capability and automatic armament triggering will become more insistent as the interception problem grows increasingly acute. The combinations of speed and height now threatened—if not by heavy and medium bombers, then by supersonic fighters masquerading as bombers and carrying atomic weapons—are gravely menacing, and human faculties will be sorely taxed unless unstinted electronic aid is forthcoming. This will apply notwithstanding the ultimate self-directing powers of the guided air-launched weapon. Already in prospect is an automatic interception procedure for the Convair F-102, entailing the direct control of the fighter, immediately it is airborne, by a ground station. The target having been picked up by the fighter's own radar, missiles will then be launched automatically and the ground controller will take over once more to return the aircraft to base. The pilot's responsibility will be little more than that of taking off, landing and switching from one control to another.

After languishing for a period, the concept of the pilotless interceptor is again prominently in the picture, disclosures having been made early this year concerning the SAGE (semi-automatic ground environment) system and its possible rôle in the continental air defence of the United States. By this system pilotless interceptors would be directed to their quarry and back to base quite automatically. The scheme would materialize (according to the U.S.A.F. Assistant Deputy Chief of Staff for Operations) "when the time arrives that we have faith and confidence in the reliability and accuracy of the equipment, and when the fighter's ability . . . to return to base after air combat to fight again makes it cheaper than the one-way guided unmanned missile."

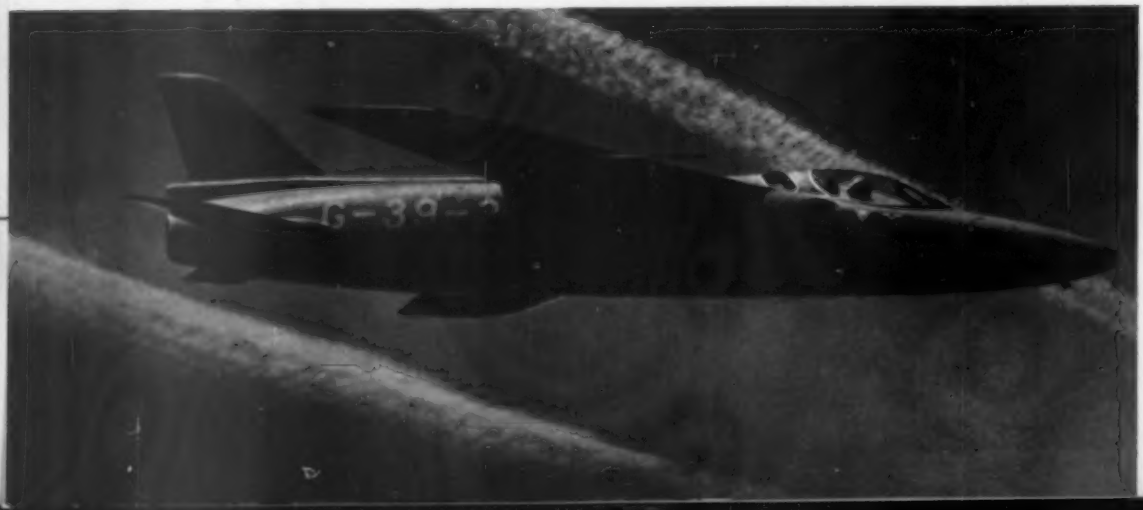
It is suggested that radar data obtained from early-warning aircraft and water-based picket ships might prove incompatible with the automatic computors used in SAGE, because of motions of the aircraft or ship. In conjunction with the SAGE system flight-plans for all civil and military aircraft would be fed into digital computors and automatically stored for reference. Were an unknown to be picked up its track would be transmitted to a computor, which would instantly search its "memory" for a corresponding flight plan. If the "unknown" plot matched the expected position of a known aircraft within acceptable limits the computor would reject it as friendly and the blip would no longer be displayed in the control rooms.

In the matter of speed, Mach 2 is no longer the goal. Already the Lockheed Starfighter has achieved it, or something near it—though with what bewildering results for the pilot, as witness Tony Levier, who tested the first prototype. "One pass at the enemy plane," he says, "and you don't see him for a couple of months"; and he went on to remark that stretching combat time two or three minutes would mean the use of ten or twenty times more fuel than it took for cruise—could mean that the pilot would not get home.

Until recently the U.S.A.F. had apparently been considering the adoption of a class of aircraft known as a long-range interceptor and able, it was thought, to engage raiders 1,500 miles out from target. These fighters would, of course, have come out extremely heavy, and North American's entry for the design contest is known to have been designed around four 12,000 lb turbojets plus reheat—a far greater thrust than will be needed by the DC-8 intercontinental airliner. Not surprising, perhaps, the planning staffs reconsidered, and it now appears that they are thinking in terms of a "medium-range" interceptor of lighter weight and higher performance. This should be able to intercept at about 800 miles from base, and, unlike the "long-range" machine, should fit into the present continental defence system with its relatively short-range radar warning system.

The range-requirement for such interceptors apparently arose because airfield and missile installation construction costs in the

Folland Gnat.



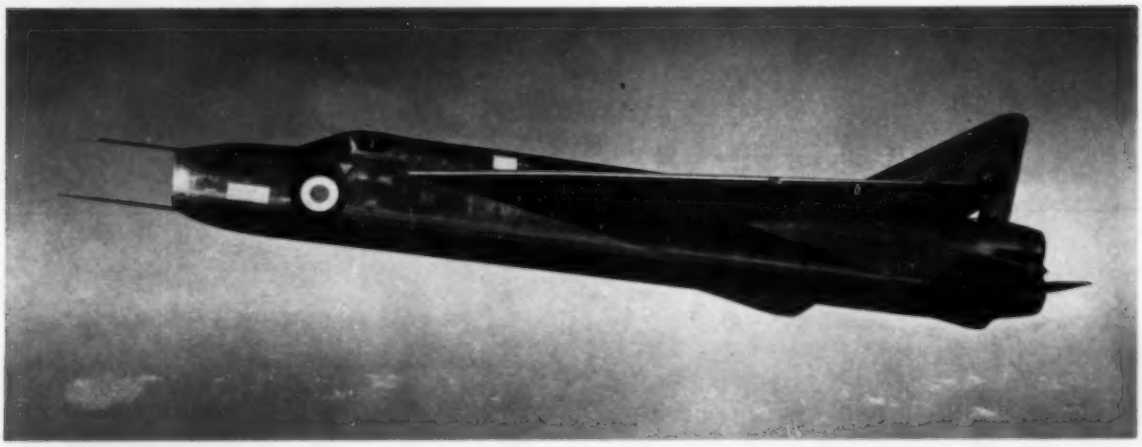
Far North had been found to run from five to seven times those of comparable installations in more temperate climes. The U.S.A.F. Assistant Deputy Chief of Staff for Operations has said, "Present thinking is that the U.S. will get more air defence for its dollar by basing five to seven squadrons of long-range intercepters in the U.S. than by basing one squadron in the Far North."

Whether the new intercepters will be the bearers of the Douglas Ding-Dong nuclear-headed air-to-air missile remains to be seen.

Meanwhile, as missile development pursues its uncertain course, the gun may retire from the fighter scene with a metamorphosis—into General Electric's "Gatling" multi-barrel 20 mm firing system, rotated at very high speed by an external power source to give a rate of fire of perhaps 6,000 r.p.m. (Shades of the Accles gun, proposed for the Westland F.7/30 fighter of the early 1930s.)

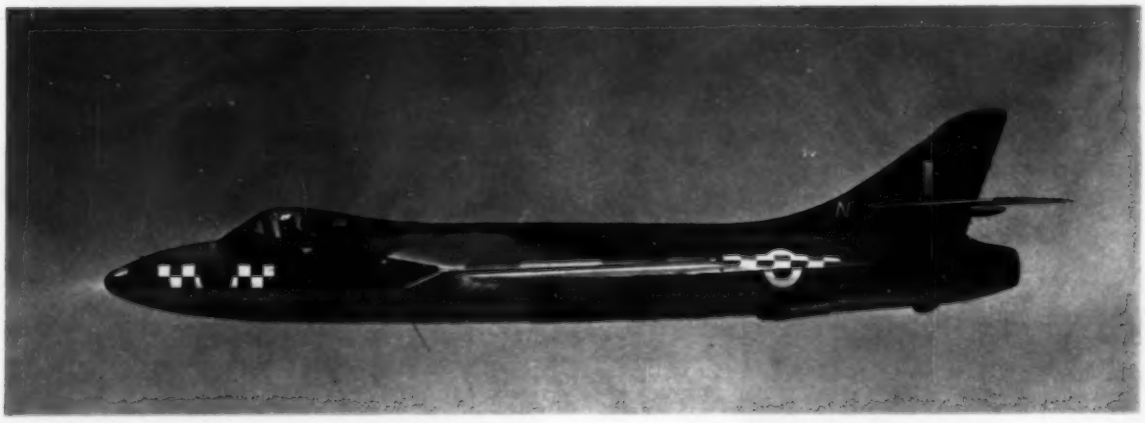
Among the fighters hereafter reviewed, the Ryan X-13 alone represents the pure-jet V.T.O. formula, which may yet come into its own for certain shore- and ship-based applications. The zero-length launching scheme, as investigated by Glenn Martin, using a Republic Thunderjet, remains as a further possibility, probably in conjunction with skid landing. Meanwhile, in France Sud-Est are going ahead with their trolley/skid system for the Baroudeur attack machine. Though neither the Lockheed nor the Convair airscrew-driven, V.T.O. research fighters will be developed to operational standard, the possibility remains that such a machine might yet prove its worth in second-class warfare, if only in the attack rôle.

FIGHTERS | SINGLE-SEAT, LAND-BASED



English Electric P.1.

Hawker Hunter F.5.



GREAT BRITAIN

de Havilland Venom F.B.4 An established type of R.A.F. day intercepter or fighter/bomber, this Venom single-seater, in common with other variants of recent production, has the advantage of hydraulically operated ailerons, incorporating artificial feel and having provision for automatic reversion to full manual control in emergency. This control system was perfected on a modified Venom F.B.1 (which version continues in service) and is claimed by the makers to confer a considerable gain in combat efficiency. Further benefit is derived from redesigned fins and rudders and the addition of dorsal fins.

The turbojet is a de Havilland Ghost (reported as a Ghost 103 of 4,850 lb thrust, though a much-improved rate of climb and ceiling should be possible with the latest—5,300 lb—Ghost 105), and the built-in armament is four 20 mm British-Hispano guns. The wing is stressed for combat manœuvrability with tip-tanks full.

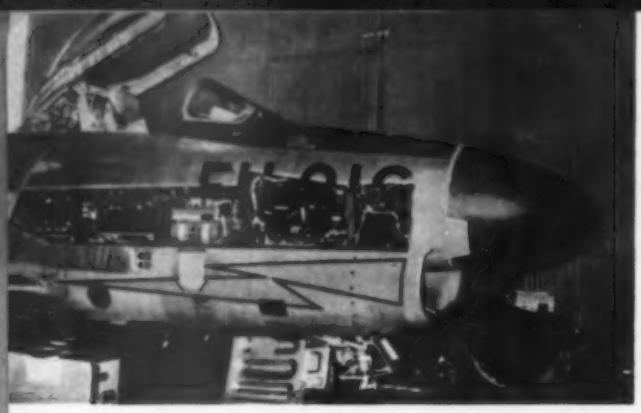
Single-seat Venoms (F.B.1 and F.B.4) are serving in Switzerland, Burma and Iraq as well as with the R.A.F. squadrons in Germany and overseas. Production continues.

Span, 41ft 9in; length, 33ft; maximum speed well over 600 m.p.h.

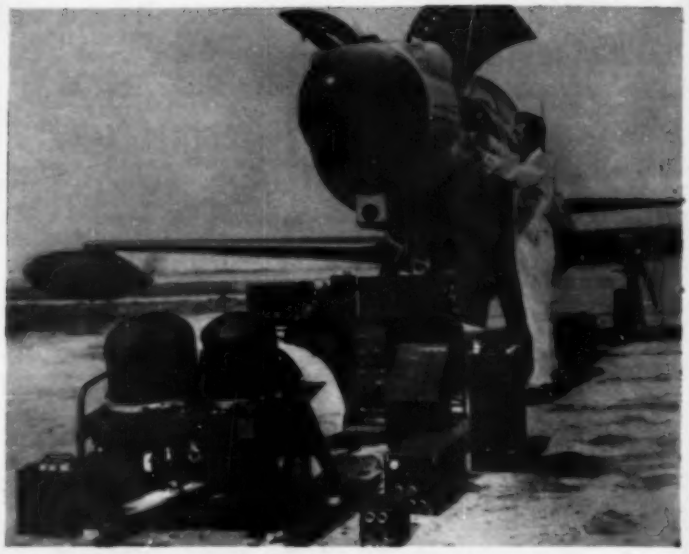
English Electric P.1 Formerly known by its specification number, F.23, the P.1 ("Pursuit 1") is a twin-jet intercepter destined as a replacement for the Hawker Hunter in the Royal Air Force and under active consideration by other Governments. Two of the five prototypes ordered are at present flying—the first since August 4th, 1954—and 20 pre-production machines for development work on systems, installations and techniques are making "good progress."

The concept of the P.1—and the word can be justly applied to this fighter—dates from the late 1940s. Basic characteristics were settled within a year and an exceptionally thorough programme of research was put in hand, entailing the procurement of much expensive equipment, including the first transonic wind tunnel of its type in the United Kingdom.

The selected power-plant was a pair of Armstrong Siddeley Sapphires, the intake for which was located, after much deliberation, in the nose.

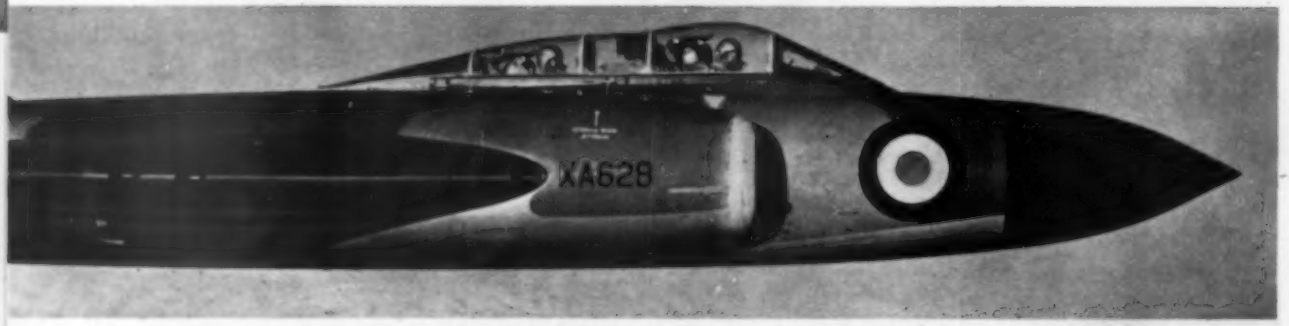


Electronic equipment in the North American F-86D Sabre.



Electronic equipment of the Lockheed F-94C Starfire.

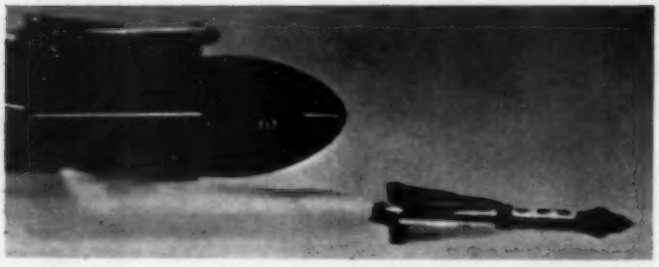
Fighters in Close-up



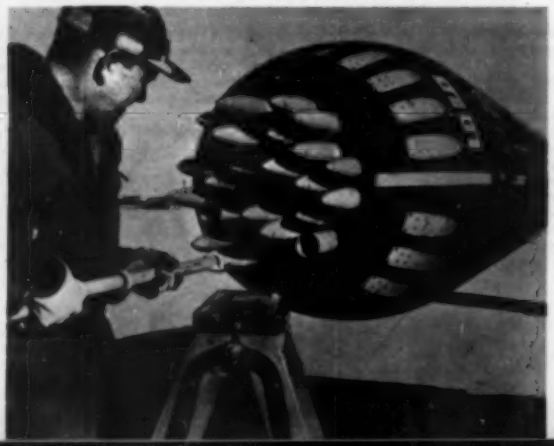
Radar nose and wing gun-ports (for four 30 mm Aden guns) of the Gloster Javelin FAW.4.

(Right) Launching a Falcon air-to-air homing missile from a Northrop F-89H Scorpion.

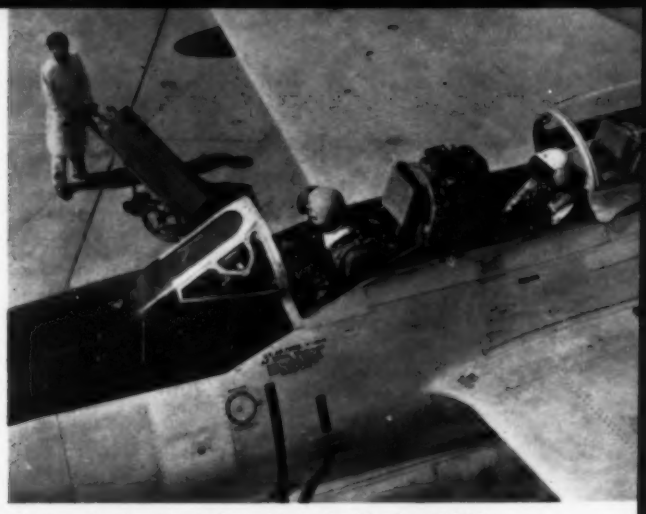
Cockpit of Northrop F-89C Scorpion.



(Below) Loading Mighty Mouse 2.75in folding-fin air-to-air rockets into a wing-tip pod of a Northrop F-89D Scorpion.



Winching up the 4×30 mm gun pack of a Hawker Hunter.



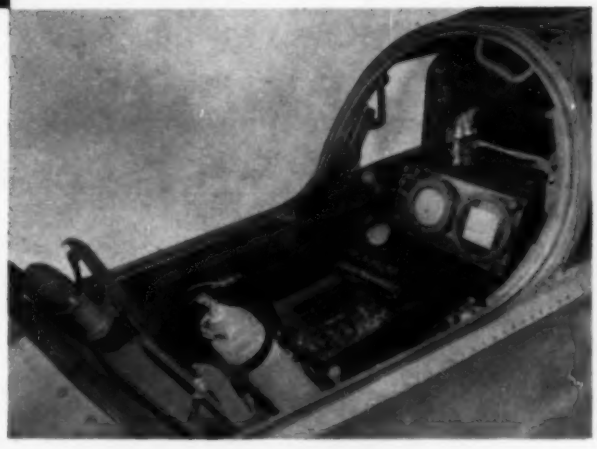
Pilot's and radar operator's positions of a Northrop F-89D.

Installation of M-39 guns in North American F-100C Super Sabre.

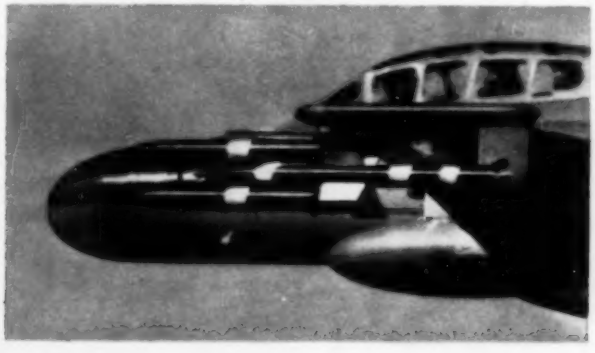
(Upper right) Inspecting the radar of the S.O.4050N Vautour.

(Right) Radar operator's station of the S.O.4050N Vautour.

(Below) Cockpit and air intakes of Convair F-102.



(Below) Experimental installation of Fairey Fireflash air-to-air guided missile on wing tip of Meteor N.F.11.



MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

The engines themselves are mounted one above, and to the rear of, the other, and each has its own set of ground-running intakes. Afterburners have been installed on the first prototype and will doubtless be standard equipment on all future examples.

The fuselage is basically a deep rectangular structure, and though (as was remarked in a dissertation on the aircraft in *Flight* of December 2nd, 1955) its form appears "unaerodynamic" to eyes accustomed to subsonic shapes, it has a far better distribution of cross-sectional area than machines of more conventional form.

The wing, which has been aptly described as a "notched delta," has a leading-edge sweep of 60 deg and a thickness/chord ratio of perhaps 5 per cent. Subtle changes in profile can be discerned at various points (the inner leading edge is drooped), these having been introduced following experience with the Short S.B.5 aerodynamic test vehicle. Small "saw-cut" slots, parallel with the incident air flow, act as wing fences. The tailplane is of the slab type, similar in plan-form to the wing.

Much of the fuel must be carried within the wing, and provision may be made for guns in addition to the guided missiles which will, of course, form the principal war load. Armament has, in any case, been officially described as "very heavy," and should certainly be superior to that of the P.1's American rival, the Lockheed Starfighter. Gun and missile "packs" appear feasible, and the missiles themselves might be of the reported de Havilland type, using infra-red detection.

An ingenious undercarriage was devised for the P.1 in conjunction with British Messier, the main leg being hinged roughly in the geometric centre of the wing and folding outward. The nose leg retracts forwards and the single wheel lies flat under the intake duct.

Within a few days of its maiden flight the P.1 exceeded the speed of sound in a dive on several occasions and shortly thereafter was regularly flying at Mach numbers in excess of 1 in level flight without the use of afterburning or any other form of power-boosting device. In March this year it was disclosed that the first prototype had flown with reheat and that the two prototypes had completed some 300 flights, mostly in the supersonic regime and on many occasions with an R.A.F. pilot. Additional P.1s, it was added, would be flying later this year.

Unofficially it has been reported that the Sapphires will be replaced in later machines by advanced marks of the Rolls-Royce Avon and the possibility of auxiliary rocket power is obvious. With almost constant reheat (i.e., operating as a short-range intercepter) the P.1 must be stringently restricted in endurance, though this might be considerably extended by abstaining from power boost and with only one turbojet running. The two engines will in any case be greatly comforting to pilots, who recognize that complete power failure in a supersonic fighter must result not only in a high rate of descent but may also lead to the failure of the flight controls and other systems.

Demonstrated manœuvrability of the P.1 is of a very high order indeed, for the wing loading is moderate, and fly-pasts at speeds of 150 knots or less have been witnessed. Landing speed, nevertheless, must be kept comparatively high (as with other highly "swept" machines) if the tail is not to scrape the runway. Potential level speed is extremely high (doubtless well in excess of Mach 1.5) and the rate of climb is of an exceptional order.

Span about 36ft; length about 54ft.

North American F-100A Super Sabre.

McDonnell F-101A Voodoo.

Folland Gnat It is interesting and significant that when *Flight*'s previous review of military aircraft was published in June 1954 the forerunner of the Gnat light fighter (named Midge) had not even flown and no description was permissible. This machine did not, in fact, take the air until the following August, and the first Gnat followed it just under a year later. Today Folland Aircraft are rapidly setting up facilities at Hamble for production, and jigs are being erected as fast as space becomes available in order that 20-30 machines a month might be built without increasing present resources. "Keen interest" has already been shown in the Gnat by India, Finland, Holland, Belgium, New Zealand, Germany, Yugoslavia, Switzerland and Israel, and the Royal Canadian and United States Navies have investigated a carrier-borne version known as the Sea Gnat. It was stated last April that discussions concerning the sale of Gnats and their manufacture overseas were in progress with more than six countries. Up to that time 25 pilots—many from abroad—had flown the prototype, to a total of over 150 hr. A British Government order for a development batch of six is well in hand and the first was recently completed—only nine months after receipt of the contract.

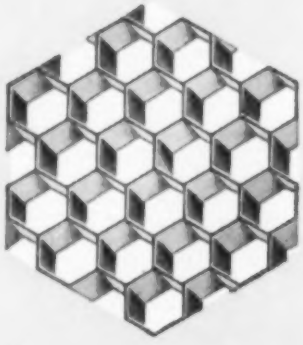
Conceived as a light, cheap, high-performance machine which could be built at a fraction of the cost of a "conventional" fighter, though at the same time perform most operations which might be demanded of a single-seat day fighter, the Gnat is powered by the outstandingly promising and notably compact Bristol Orpheus turbojet and is characterized by a high wing and low-set tail surfaces. This combination is claimed to confer the advantage that excessive down-wash from the wing does not strike the tailplane during turns and other manœuvres

Chosen by twenty-two national air forces
throughout the world for advanced flying
and weapons training

DE HAVILLAND VAMPIRE TRAINER

(de Havilland Goblin engine)

Worth its weight in . . . ?



For many structural applications there is no material to compare with metal honeycomb core bonded to metal skins. "Sandwich" constructions of this kind enable weight savings on a considerable scale to be used for improved payloads, and . . . the saving is achieved without detriment to strength or rigidity.

'Redux' adhesives make sandwich structures possible. 'Redux' Film 775 R simplifies the bonding of metal skins to honeycomb cores and now we are producing the honeycomb itself. Aero Research honeycomb is supplied in cell sizes of ⅛, ¼ and ½ in. inscribed circle, each available in wall thicknesses of .001, .002 and .003 in. It is made in a range of depths.

Our seventeen years' experience of honeycomb structures is at the disposal of designers and production engineers. Honeycomb information sheets will be sent gladly on request.

HONEYCOMB CORE

Aero Research Limited *A Ciba Company, Duxford, Cambridge. Sawston 187*

SBAC

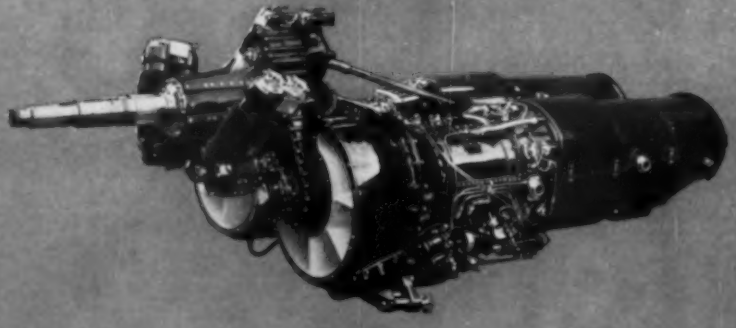
AP. 264-209

All turboprop-powered aircraft in Fleet operation with the Royal Navy are fitted with Rotol propellers and gearboxes

ROTOL

Proof before prophecy..

It is not our business to debate the future, but to build it. Progress in the air is won, we believe, by ruthless concentration on the present task. Our first duty is to create aircraft engines which fulfil required functions under all conceivable conditions—engines such as the compact Double Mamba turboprop, now successfully serving the special needs of the anti-submarine Fairey Gannet in squadron service with the Royal Navy. Our responsibility then lies, as we see it, in the searching and systematic development of these proven types, in order that they may match the evolution of aircraft design with progressive yet predictable performance.



ARMSTRONG SIDDELEY AERO ENGINES

ARMSTRONG SIDDELEY, COVENTRY & BROCKWORTH

Members of the Hawker Siddeley Group

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

and thus destroy its stabilizing effect. An extremely high rate of roll is conferred by the inboard ailerons without imposing any undue twisting forces on the wing. The air brakes are in the form of metal fairings attached directly to the three legs of the undercarriage. Armament is two 30 mm Aden guns, the barrels of which are in the air-intake fairings. Standard equipment includes VHF radio and standby, gyro gunsight and radar ranging, supplementary oxygen, braking parachute and lightweight, fully automatic ejection seat.

As an intercepter the Gnat can climb to 40,000ft in little more than three minutes, and readily attains supersonic speed in a shallow dive. Reference has been made in the foreign press to a Gnat 2 intercepter having Orpheus with reheat and weighing less than 10,500 lb all-up. This would have a wing of 6 per cent thickness.

Span 22ft 2in; length, 29ft.

Gloster Meteor F.8 Though a number of R.A.F. and R.Aux.A.F. squadrons continue to use this twin-Derwent intercepter (585 m.p.h. at sea level; initial rate of climb 6,950ft/min), the type is fast being superseded by the Hawker Hunter. Meteors of this mark are serving in Belgium, Brazil, Denmark, Egypt, Israel and also the Netherlands.

Hawker Hunter F.1 The original prototype of the Hunter F.1 (known at the time by the Hawker type number P.1067) was first flown on July 20th, 1951, and R.A.F. squadrons began to receive production F.1s during the second half of 1954. These remain in serivce and are powered by Rolls-Royce Avons, reported to be of the RA.7 type.

Hawker Hunter F.2 Similar in structure, armament and equipment to the F.1, this mark has an Armstrong Siddeley Sapphire turbojet (unofficially stated to be an ASSa.6) instead of an Avon. Hunter marks F.1 and F.2 were succeeded on the production lines by the F.4 and F.5, later described. Marks F.2 and F.5 have been built solely by Armstrong Whitworth, at Coventry.

Hawker Hunter F.4 Commonest of the Hunter variants, the F.4 has the same (Avon) engine as the F.1. It is superior, however, in having increased fuel capacity in the wings and in its ability to carry under-wing stores, including auxiliary tanks.

Together with its ammunition supply of about 100 rounds per gun, the armament of four 30 mm Aden guns (cyclic rate of fire 1,200 rounds a minute; electrical percussion) is made up as a quick-change "pack," and is used in conjunction with automatic gun-ranging radar contained in the forward fuselage. The scanner is in the extreme nose, enclosed by a laminated plastic radome. Being linked with the gyro gunsight, the radar provides automatic ranging, and is controlled by a twist-grip on the power lever.

The new and extremely heavy armament of the Hunter brought about some knotty problems of installation and operation, and these were the subject of a statement by the Minister of Supply earlier this year. He recalled that the first difficulties encountered related to engine surge when the guns were fired; but these occurred only in "certain marks" of the Hunter (understood to be those with Avon engines), and only at certain heights. In any case, he said, that particular problem had been solved, and the necessary modifications to the engines were being made retrospectively. The gun-firing limitation which remained (March 1956) was not one that prohibited firing but one which limited the amount of firing possible. The "enormous kick" of the gun battery was damaging small components in the nose and modifications had been devised to strengthen the parts concerned. Hunters at present in service carry external collectors for the links of the ammunition belts.

Although the standard Hunter F.4 is not equipped to carry guided missiles, it might conceivably be armed with 60 mm air-to-air rocket projectiles, as developed at the Royal Aircraft Establishment. A 31-tube pod, with glass plastic perforated nose, and a 7-tube plain pod are known to have been developed and firing experiments have been made from a Meteor.

Provision is made, in this and succeeding Hunter marks, for 100-gallon pylon-mounted, finless, plastic under-wing fuel tanks of Bristol manufacture.

Although incapable of supersonic speed in level flight, the Hunter F.4 achieves this with ease in a shallow dive. All-round performance and handling characteristics are of a high order and the machine is very much a "pilot's aeroplane." It is notable, too, for its short "turn-round" time after an operational sortie, and *Flight* representatives have watched a Hunter ground crew remove the gun panels; detach the barrels; lower the gun pack on to a special trolley; replace the barrels; winch up a new re-armed pack weighing some 1,900 lb; re-charge the oxygen bottles; change cine-film; and completely refuel the aircraft by means of a high-pressure valve in an elapsed time of 5 min 42 sec.

The Hunter F.4 is the model selected by the air forces of Belgium, the Netherlands, Denmark and Sweden (where it is known as the J34 and where it will serve as the standard intercepter until J35 Drakens become available). Production is under way in Belgium (S.A.B.C.A. and Avions Fairey) and in Holland, by Fokker, as well as at the Hawker factories at Kingston and Blackpool. Orders may be summarized thus: for R.A.F. Fighter Command, an undisclosed but "substantial" number; for NATO, 958, made up as 468 for the R.A.F. under off-shore contracts, 112 to be built under licence by Fokker in Holland and by S.A.B.C.A. and Avions Fairey in Belgium (also under off-shore contracts), 156 to be built in Holland by Fokker for the Dutch Government, 192 to be built by S.A.B.C.A. and Avions Fairey for the Belgian

Lockheed F-104 Starfighter.

Right, Convair F-102A.

North American F-86H Sabre.

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

Government, and 30 for Denmark, to be built by Hawker in Great Britain. Sweden, a non-NATO nation, has ordered 120 Hunters at a price of £12 million, so that, quite apart from the Ministry of Supply contracts on behalf of the R.A.F., nearly 1,100 Hunters are on order from the various factories. (These orders were followed late in 1954 by an M.D.A.P. contract delivered by U.S.A.F.E. for £367 million worth of Sapphire-Hunters and Javelins for the R.A.F., though the numbers of each type were not stated.)

Span, 33ft 8in; length, 45ft 3in.

Hawker Hunter F.5 This version is similar to the F.4 but has an Armstrong Siddeley Sapphire turbojet instead of an Avon. It forms the equipment of a number of R.A.F. squadrons.

Hawker Hunter F.6 A development of the F.4, the F.6 has a later version of the Avon, said to be the RA.28 of five-figure thrust, which confers a higher rate of climb and increased ceiling. All-out level speed, however, is probably little superior to that of the F.4 by reason of aerodynamic limitations. The F.6 is distinguishable by its enlarged tailpipe and may eventually be fitted with an all-flying tail.

Development of a Hunter variant having a thinner, more sharply swept wing and easily capable of supersonic speed on the level, was abandoned, but a version to carry the Fairey Fireflash air-to-air missile is under development for export.

Saunders-Roe S.R.53 It was disclosed last November that Saunders-Roe, Ltd., were building prototypes, "for early completion," of a supersonic turbojet-plus-rocket intercepter for future R.A.F. service. No details may be divulged, but it has been reported that the rocket is a de Havilland Spectre, and the turbojets may be Armstrong Siddeley Vipers.

Vickers-Supermarine Swift Although the Swift will not enter R.A.F. service in its intended rôle of intercepter fighter, it is already equipping certain fighter/reconnaissance units and in that capacity is dealt with under the appropriate heading. An unspecified mark of Swift, possibly the F.6, is to be used for gaining experience with air-to-air guided weapons, and a Swift F.1 is employed by de Havilland Propellers, Ltd., as an experimental missile carrier.

AUSTRALIA

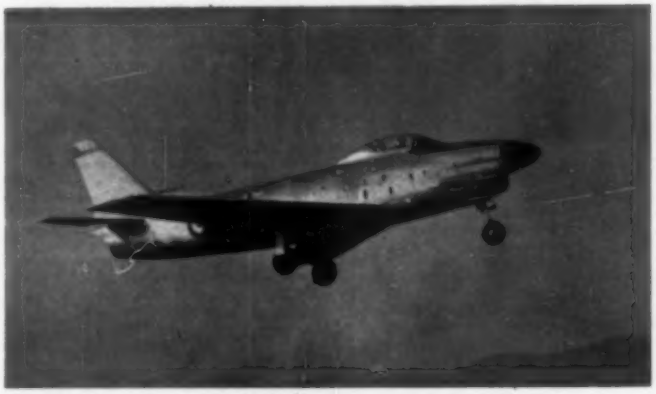
Commonwealth Avon-Sabre (CA-27) The decision to build in Australia a developed version of the Sabre was taken in 1951 and the resulting product, now establishing itself in service with the Royal Australian Air Force, is a machine of uncommon merit. Powered by a Commonwealth-built Rolls-Royce Avon 20 of some 8,000 lb thrust this fighter is armed with two 30 mm Aden guns and is equipped for the carriage of external stores up to 4,000 lb in total weight. It has been officially stated that guided weapons will eventually form the principal armament. The first prototype flew in August 1953 and since the initial order was placed for 72 aircraft this has been increased to 90. Further contracts are in prospect.

Structural changes necessitated by the new powerplant meant that only about 40 per cent of the original fuselage could be retained. The size of the intake-duct had to be increased, so the front fuselage was split horizontally and a "wedge" inserted.

Span, 37ft 1in; length, 37ft 6in; gross weight about 17,000 lb.

CANADA

Canadair Orenda-Sabre (Sabre 5) This first production version of the Orenda-Sabre was a development of the Mk 3 and is characterized by the "6-3," or "hard" leading edge and an Orenda 10 turbojet of 6,500 lb thrust. The first production machine flew in the summer of 1953 and Sabre 5s represented a large proportion of the 1,350 Canadair-



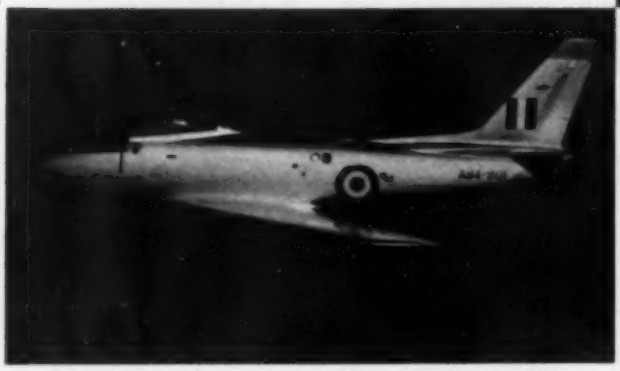
Fiat-built North American F-86K Sabre.

Below, Republic F-84F Thunderstreak

(Right) North American F-86D firing a salvo of Mighty Mouse 2.75in folding-fin rocket projectiles.

(Bottom) Canadair-built North American Sabre 6.

(Below) Avon-Sabre, built under licence in Australia by the Commonwealth Aircraft Corporation.



built Sabres completed between 1950 and the summer of 1955. Production was then at the rate of one aircraft a day.

Canadair Orenda-Sabre (Sabre 6) In production for several months this version has the 7,500 lb-thrust Orenda 14 with two-stage turbine and having reduced weight and improved specific fuel consumption. Like its predecessors, it is armed with six 0.5in Browning guns, but provision may eventually be made for carrying Hughes Falcon missiles.

The Sabre 6 is the standard intercepter of the R.C.A.F. and 37 examples of the type are being acquired by South Africa. The first South African machine was the 1,459th Sabre to leave the Canadair line. Earlier marks are serving with the air forces of Great Britain, Greece and Turkey.

Span, 36ft 1 in; length, 37ft 6in; gross weight, about 16,000 lb.

U.S.A.

Convair F-102A The first production version of the F-102 all-weather single-seat delta-wing fighter, the F-102A is expected to be operational in U.S.A.F. squadrons during the coming summer. The first prototype (YF-102) was flown on October 24th, 1953, but was subsequently written off; the second flew on January 11th, 1954.

Having been designed to a U.S.A.F. specification and destined to be the standard single-seat all-weather intercepter of that Service, it can be imagined what consternation resulted when it was found that the original form of the aircraft proved incapable of a Mach number superior to 0.9, notwithstanding its very thin wing. The type was, of course, intended to be supersonic and rumour went round that the contract would be cancelled. Forthwith a model similar to the YF-102 was tested in the 8ft tunnel at Langley Field and it was determined that the drag "hump" rose to a value beyond the capability of the aircraft. The position was discussed with the Langley aerodynamicists and it was decided that the area rule (*Flight* of September 30th, 1955) would provide the only solution. The design was thus altered to conform to the new concept, the nose being lengthened, the fuselage waist pinched amidships and prominent bulges being added at the tail. By October 1953 it was seen that the F-102A would after all be supersonic, and during 1954 Mach 1 was passed on the climb.

The thinness of the wing (about 5 per cent) has necessitated carrying all the fuel and military load in the fuselage. In the belly section is a bay for six Hughes Falcon air-to-air missiles; alternatively, this can be occupied by ferrying tanks. The pointed nose section is a reinforced plastic radome for the Hughes electronic missile-guidance system.

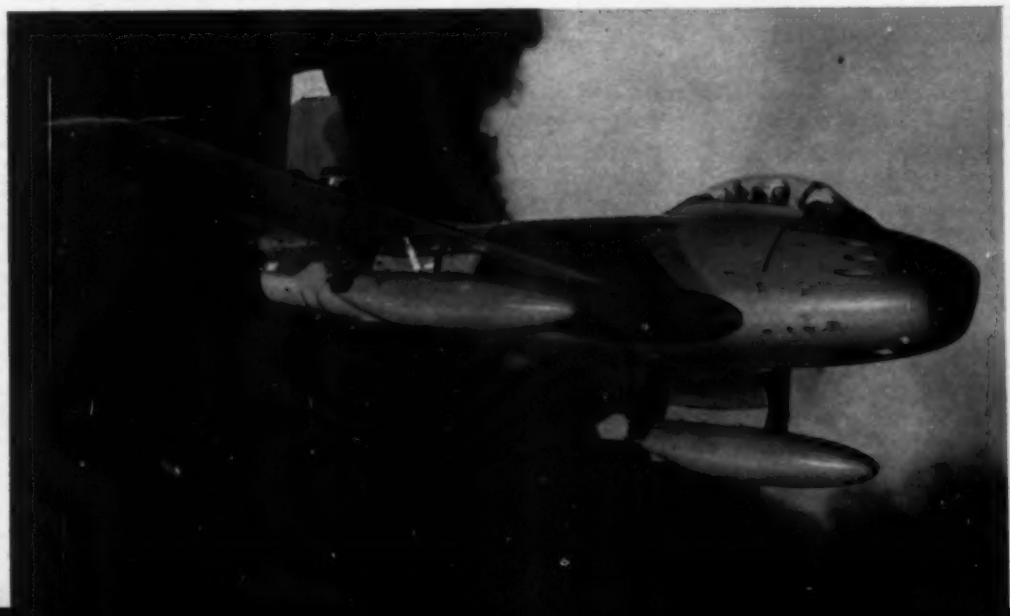
Here it may be remarked that the Falcon, being equipped with its own radar homing head, is capable of tracking and striking a manœuvring target when launched at considerable range and with marked disparity in height between the intercepter and the target. While allowing greater latitude in the firing run, however, it requires much more complex equipment since the missile's gyros must be spun up and its motor started and the radar locked on at the right times before launching. Later versions of the F-102, it is reported, are to be fully automatic, to the point at which the aircraft can be directly controlled through a pulse-coded radio data link by the G.C.I. station as soon as it gets airborne. When the target comes within range of the intercepter's own radar, the aircraft's equipment will take over and the missile(s) will be launched. Then, once again, the ground station will take over to bring the intercepter back to base. The pilot will have relatively little to do except switching from one control to another, taking off and touching down.

The fuel tankage is integral and could be seriously damaged by over-fuelling or excessive pressure, so a special single-point pressure-refuelling system, incorporating a new type of vent valve to permit very high fuelling rates with safety, is installed. Housed in a box with sideways-opening doors above the tailpipe is a braking parachute.

Current F-102As are believed to attain Mach numbers superior to 1.2 in level flight and it is known that heights in excess of 55,000ft have been achieved. The early machines had the Pratt and Whitney J57-P-11 turbojet, but subsequent production aircraft are having the J57-F-23 or J57-P-35, the last-named delivering a total thrust, with afterburner, of some 17,200 lb. An experimental F-102A is reported to have been flying with an enlarged fin to improve stability at high speed and this will eventually be standard.

Span, 38ft; length, 68ft; gross weight, over 30,000 lb.

Convair F-102B This development of the 102A will be powered with the Pratt and Whitney J75 turbojet, having a total thrust, with



MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

afterburner, of some 24-25,000 lb. The prototype should fly this autumn.

Convair TF-102A A two-seat (side-by-side) "combat proficiency" trainer development of the 102A, this sub-type is also capable of serving "as a tactical weapon." Modifications to the cockpit canopy are reported to have been necessary to eliminate buffeting just below Mach 1.

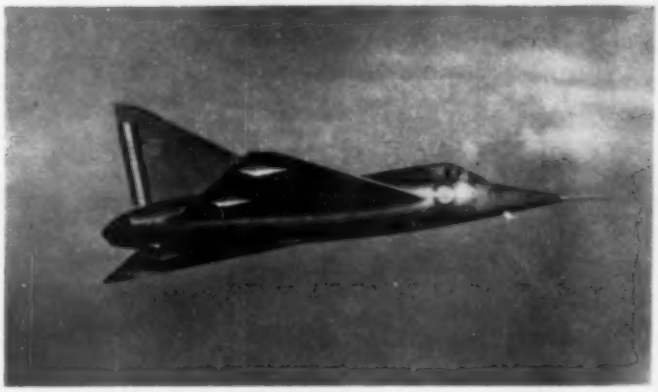
Lockheed F-104A Starfighter This comparatively light, extremely fast and high-flying machine—regarded in the first instance as an air-superiority fighter—is perhaps the most sensational aircraft of its class built since the war. Its design was very fully discussed by the Technical Editor in *Flight* of April 20th, and the succeeding issue contained some exclusive close-up photographs. Production for the U.S.A.F. is well under way.

Though prototype aircraft were powered by the Wright J65 (Armstrong Siddeley Sapphire) turbojet, production "A"s have the General Electric J79-GE-3. A key design-feature is the extremely thin, unswept wing, with pronounced anhedral. The half-wings are cantilevered from the fuselage, so allowing a mid-wing arrangement, with something like a 12 per cent reduction in drag compared with a low-wing layout. Each half-wing measures rather less than 8ft in span and the 10-degree anhedral was necessary because the vertical tail surface projected above the fuselage was roughly equivalent to each half-span, so the rudder had considerable influence on rolling behaviour, and tended to act as an aileron.

It was remarked in our original description that as the F-104 has greater span-loading than any other combat aircraft, induced drag became serious towards the lower end of the speed range and particularly acute at high altitudes. "This fact," it was observed, "must tend to put the 104 in the unfortunate class of aircraft where enormous 'island performance' exists at high altitude and high supersonic speed, but where the medium-altitude, medium-speed conditions leave little in hand for climb and acceleration. At present, however, the F-104A (without external stores) can get through the upper limits of speed and altitude in the matter of a few minutes."

To improve wing behaviour at high angles of attack the leading edge can be drooped some 20 deg. Jettisonable tanks, each holding about 200 U.S. gallons, fit over the wing-tips, and though they increase supersonic interference drag, they exert a beneficial end-plate effect equivalent to an increase in span. Lateral control is by means of deep-chord, small-span gapless ailerons, hydraulically operated, and control in the pitching plane is by means of a slab tailplane mounted near the tip of the fin. Lear three-axis stability augmentation is reported and a braking parachute is standard equipment. Downward seat-ejection is incorporated for the first time in a production-type fighter.

The fuselage carries more fuel than did the twin-piston-engined Lightning, and the makers claim that the Starfighter's range is "comparable to that of present operational jet fighters." The J79 turbojet is a unit of extreme efficiency and in spite of the startling advance in performance conferred by this engine (Mach 1.85-2), the miles per gallon figure remains roughly the same as with the J65. The precise form of the lateral air-intakes remains secret, but they are reliably reported to embody shock-forming "wedges," extending well forward, to give multi-shock diffusion. Inlet control is probably effected by a Minneapolis-Honeywell system.



Marcel Dassault Mirage.

(Left) S.N.C.A.S.O.9050 Trident I.

We quote again from our original description: "Under some conditions thrust exceeds weight and the maximum rate of climb is obtained at maximum forward speed. It is officially stated that, so far as can be determined, the J79-powered machine is the fastest climber in the world. LeVier [Lockheed test pilot] once commented on the effects of doing levels at 30,000ft and then zooming to 70,000ft in a matter of seconds; and there seems no reason why, at full speed, such a height should not be maintained."

The present F-104A is fitted with a radar gun-sight but has no search radar. Armament is thought to be Project Vulcan—the "Gatling" combination of six barrels with a rotary firing system referred to in our introduction. With full military load the maximum weight is probably some 15,000 lb, and 17,000-18,000 lb may be in prospect. Operational ceiling is above 65,000ft and probable radius of action about 500 miles at the tropopause.

Span, 21ft 11in; length, 54ft 9in.

Lockheed F-104 (All-weather Version) An unconfirmed report mentions a possible all-weather version of the Starfighter, having lightweight radar and armed with two Hughes Falcon air-to-air missiles. This is described as an "inner-defense intercepter for Air Defense Command."

McDonnell F-101A Voodoo The Voodoo is the largest, heaviest, one of the fastest, and among the most important single-seaters soon to become available for Western defence. The "A" version is a long-range strategic fighter or fighter/bomber, the first prototype of which flew during October 1954. Though based on the design of the XF-88 of some eight years ago, it is, in fact, a totally new and far bigger machine, powered with two Pratt and Whitney J57-F-13 turbojets having short afterburners and fed from wing-root intakes. Total thrust, with reheat, is about 30,000 lb. The wing is very thin, is swept through 35 degrees, has a very small relative area, and is of characteristic kinked plan-form. It is built up of heavy, tapered, pre-formed sections. Surface loading is well in excess of 100 lb/sq ft and to mitigate the effect of this a flap-blowing system is incorporated. Internal fuel capacity—mainly in the fuselage—is thought to be of the order of 2,000 gallons, and provision is made for three or more auxiliary tanks and for in-flight refuelling by the probe/drogue and pod/boom methods. The built-in armament of four 20 mm M-39 (firing rate 1,500 r.p.m.) guns can be supplemented by three Hughes Falcon air-to-air missiles and two clusters each of three unguided folding-fin rockets.

Air brakes of very large area are carried on the cranked inboard sections of the wing and the ailerons are located at mid-span to avoid reversal due to wing twist. A slab tailplane is mounted high on the low-aspect-ratio fin and in the extreme tail is a housing for a braking parachute. Unofficially the Voodoo has been credited with a maximum speed of over 1,000 m.p.h. and certainly the first F-101A exceeded Mach 1 on its maiden flight.

Nord 1500 Griffon.

The F-101As are intended for Strategic Air Command and the first true production machine should be coming through in June. By April this year 31 development Voodoos were reported to have been completed.

Span, 39.7ft; length, 67.4ft; gross weight, over 40,000 lb.

McDonnell F-101B Voodoo An intercepter version of the F-101A, armed with Hughes Falcon missiles, this variant is likewise in production. Destined for Air Defense Command, it is intended to "operate under all weather conditions to execute two primary missions—the identification of unknown aircraft and their destruction if they are hostile."

North American F-86D Sabre. Although it appears likely that the Hughes Falcon air-to-air guided missile will progressively be adopted as the primary armament of this single-seat all-weather intercepter its present standard armament is a battery of 24 Mighty Mouse folding-fin air-to-air rockets, carried in a retractable tray in the belly of the fuselage. The Mighty Mouse has a calibre of 2¾in and a striking power roughly equivalent to that of a 3.7in shell. It is spin-stabilized, the four narrow-chord fins being folded while it is contained in its launching tube. Acceleration at launching is extremely high and 2,000 m.p.h. is rapidly attained. The warhead is normally set to explode at a range of about 1,000ft or upon impact.

The rocket battery is fired in conjunction with a Hughes E-4 fire-control system which, when it picks up a target, "locks on" and, by means of a Lear automatic pilot, steers the aircraft so as to effect an interception. The flight path is so controlled as to aim the fighter at the target when the latter crosses the fighter's bows. Known as collision course, or lead collision interception, this method of attack is an established procedure in U.S.A.F. squadrons.

Based on the Mighty Mouse rocket salvo, the Hughes fire-control system works in the following way. The pilot is vectored towards his target by G.C.I. in much the same way as for a stern chasing attack, but he is not placed astern of his quarry. The attack can be made theoretically from any quarter at the same height, but aircraft characteristics make a head-on approach rather dangerous and it is the object to avoid stern-chasing. The ideal is 90 deg abeam. The pilot has in front of him, in the centre of his normal blind-flying panel, a radar scope. His aerial is scanning a vertical fan beam backwards and forwards laterally, and the trace of this appears as a fast-moving vertical line on the scope. Superimposed on this presentation is a line resembling in aspect and function the horizon bar of the normal artificial horizon, so that the pilot can fly blind watching the scope alone and occasionally referring to the A.S.I or other instruments.

At a certain point the target echo will appear as a blip on the screen. Its range and bearing will be indicated by its position on the scope, vertically for range and sideways for bearing relative to the intercepter's centreline. The pilot then locks his aerial to follow the blip only by manœuvring the aerial's search trace—by manipulating a handle until the line is stationary across the blip. He then presses a switch on the grip which causes the blip to glow larger. The set is then locked on.

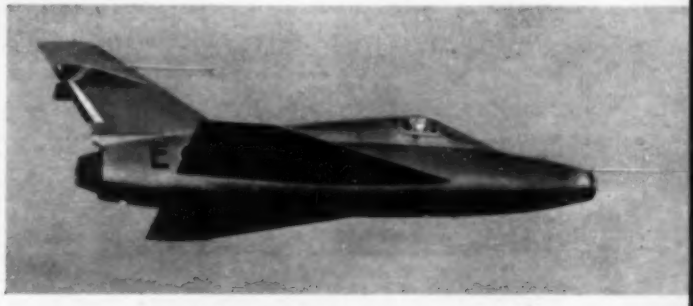
Immediately a ring appears together with a steering dot. The ring will be large in diameter and a break in its circumference will appear opposite the relevant point on a scale round the edge of the scope to indicate the rate, in feet per second, at which the intercepter is closing on the target. The steering dot will be so positioned on the scope that if the pilot manœuvres the aircraft to bring the dot into the centre of the ring, referring the while to the artificial horizon bar, his course will be correct for eventual firing of his rockets.

The distance between intercepter and target closes, and when the firing point is 20 sec away, the diameter of the large ring will decrease until it closely surrounds the steering dot. At that point the pilot must fly very accurately as the critical moment of firing is at hand. A little over four seconds short of firing, a signal on the scope tells the pilot to press the firing trigger to arm (but not fire) the rockets. He has already selected the number of rockets he wants to use. At the exact moment the rockets are fired, and a large X appears on the scope to tell the pilot he is free to break away. Should he fail to get into proper position, the X will denote a missed pass and the rockets will not be fired.

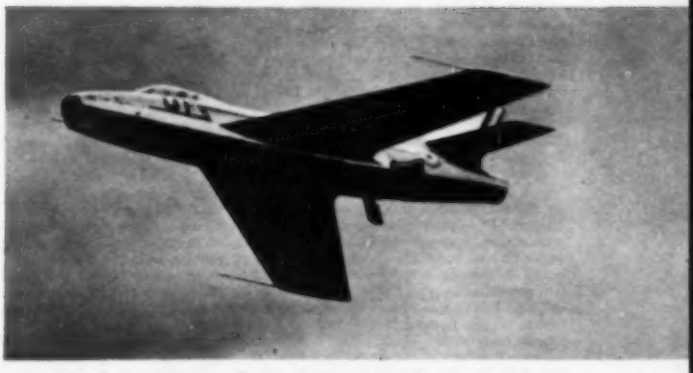
The rockets travel much faster than the aircraft towards the target, so that the intercepter can fly straight on at the same height after firing without colliding with the target. In a head-on attack, of course, actual evasive action would be required and this consists of pulling 50ft upwards under automatic control. However, the exceedingly short time available for the controls to take effect and produce this manœuvre, not to mention the lag which may occur in the aircraft, due to high indicated speed, of sloppiness at very high altitude, leave little hope of successful evasion in any but the most favourable conditions.

After the attack the radar can be set up for further interception, if any rockets remain; or it can be deflected downwards and used for map-painting and general navigation. A base so distinctively placed relative to a prominent coastal feature as Manston, where F-86Ds are operating, would give echoes probably good enough to allow a reasonably accurate approach to the glide-path in poor weather or at night with the aid of the aircraft's radar alone.

It was learned at the Fighter Weapons and Rocketry Meeting of the U.S.A.F. Air Defense Command during 1955 that maintenance of the Hughes fire-control system showed improvement over the previous year but, according to *Aviation Week*, "still had a long way to go" in reaching "acceptable reliability." The commander of the training base estimated that the great majority of misses were due not to errors on



Nord 1405 Gerfaut II



Marcel Dassault Super Mystère B.1.

S.N.C.A.S.E.212 Durandal.

Saab J35 Draken.

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

the part of the pilot or ground controller, but to inaccuracy or malfunctioning of the fire-control system. The low scores indicated that this remained a considerable problem. "As weapons go," added the commander, "this is still awfully new. We're still in the process tactically of learning to walk with it."

The F-86D (Sabre "Dog") differs from others of its breed in having the scanning equipment mounted in the nose beneath a dielectric fairing; a beard-type intake for its General Electric J47-GE-33 turbojet (nearly 8,000 lb thrust with afterburning), a slab-type tailplane without dihedral (on the later models); and a clamshell type cockpit canopy. A "parabrake" is standard equipment. Engine control is entirely automatic, relieving the pilot of all worry over such factors as tailpipe temperature and compressor stall, irrespective of the manner in which he handles the engine.

Equipment includes I.L.S., a Lear autopilot, automatic direction finder and either an omni-range radio or Sperry Zero Reader. A comparatively recent addition is an automatic landing system which couples the I.L.S. to the autopilot and permits the aircraft to be brought to within 50ft of the ground without the pilot touching the controls. First-hand examination of an F-86D discloses references to command radio, VHF/UHF antenna, servo control, flight data computor, CST1 equipment, angle of attack computor, rocket computor, marker beacon antenna, rocket temperature correction potentiometer, tape recorder and VHF navigation receiver.

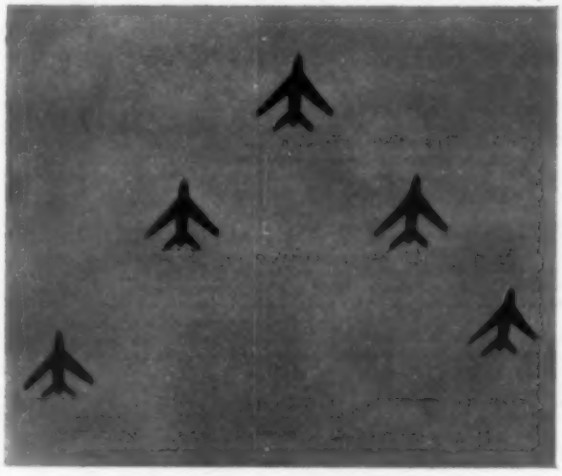
Span, 37ft 1in; length, 41ft 8in; gross weight, more than 18,000 lb; maximum speed, over 700 m.p.h.; service ceiling, over 45,000ft.

North American F-86F Sabre After production for the U.S.A.F. had ceased this fighter/bomber was reinstated on the lines, to the extent of a further 500 machines, for export to NATO countries. Powered with a General Electric J47-GE-27 engine of 5,800 lb thrust, and having anti-icing provisions, its overall dimensions are slightly larger than those of its forerunner, the "E," and it weighs about 17,000 lb all-up. Gun armament is 6 x 0.5in, and provision is made for external stores totalling 2,000 lb. (See also under "Ground Attack.")

Span, 37ft 1in; length, 37ft 6in.

North American F-86H Sabre An advanced single-seat day fighter or fighter/bomber variant of the Sabre, the F-86H has the General Electric J73-GE-3 turbojet of 9,300 lb thrust, and is armed, in its latest production forms, with four 20 mm M-39 revolver cannon (earlier variants had six 0.5in M-3 guns). Production began late in 1952 and many hundreds are in service. It has been reported that a scheme for augmenting the thrust of the J73 by burning fuel in the engine tailpipe in conjunction with a variable-area nozzle is being considered. Gross weight is over 20,000 lb.

North American F-86K Sabre The "K" variant of the F-86 is an all-weather fighter, essentially similar to the F-86D and manufactured not only by the North American parent company but in Italy also (by Fiat). Italian orders total 176. The engine is a General Electric J47-GE-33 with afterburner, but instead of the now-familiar Mighty Mouse rocket pack there are four 20 mm guns. The fire-control system is designated MG-4 and permits not only accurate firing of the guns but can be used as a navigational aid also. It provides the pilot with information which enables him to locate airborne targets, select a particular target and fly an accurate lead-pursuit course, which keeps the aircraft pointed slightly ahead of the target. It indicates the range of the target so that he can "determine the maximum firing range for his 20 mm guns," and the suggested "pull-out" time, at which point (in the words of a North American statement) the pilot should initiate manœuvres to conclude the attack. In addition, the system is said to include "beacon interrogation and ground-mapping facilities" for use as navigational aids. When ground-beacon stations are interrogated a coded response is received, which is displayed on the pilot's radar scope. Interrogation is accomplished when the radar in the aircraft transmits a signal which "triggers" the beacon, causing it to respond according to its code. The pilot can then identify the beacon station and determine his position by reading the azimuth and range information on his radar scope. Group-map operation (again we quote North American) "provides navigational information by presenting a map-like pattern of the terrain on the radar scope. Cities, lakes, rivers, mountains and coastal areas are usually recognizable."



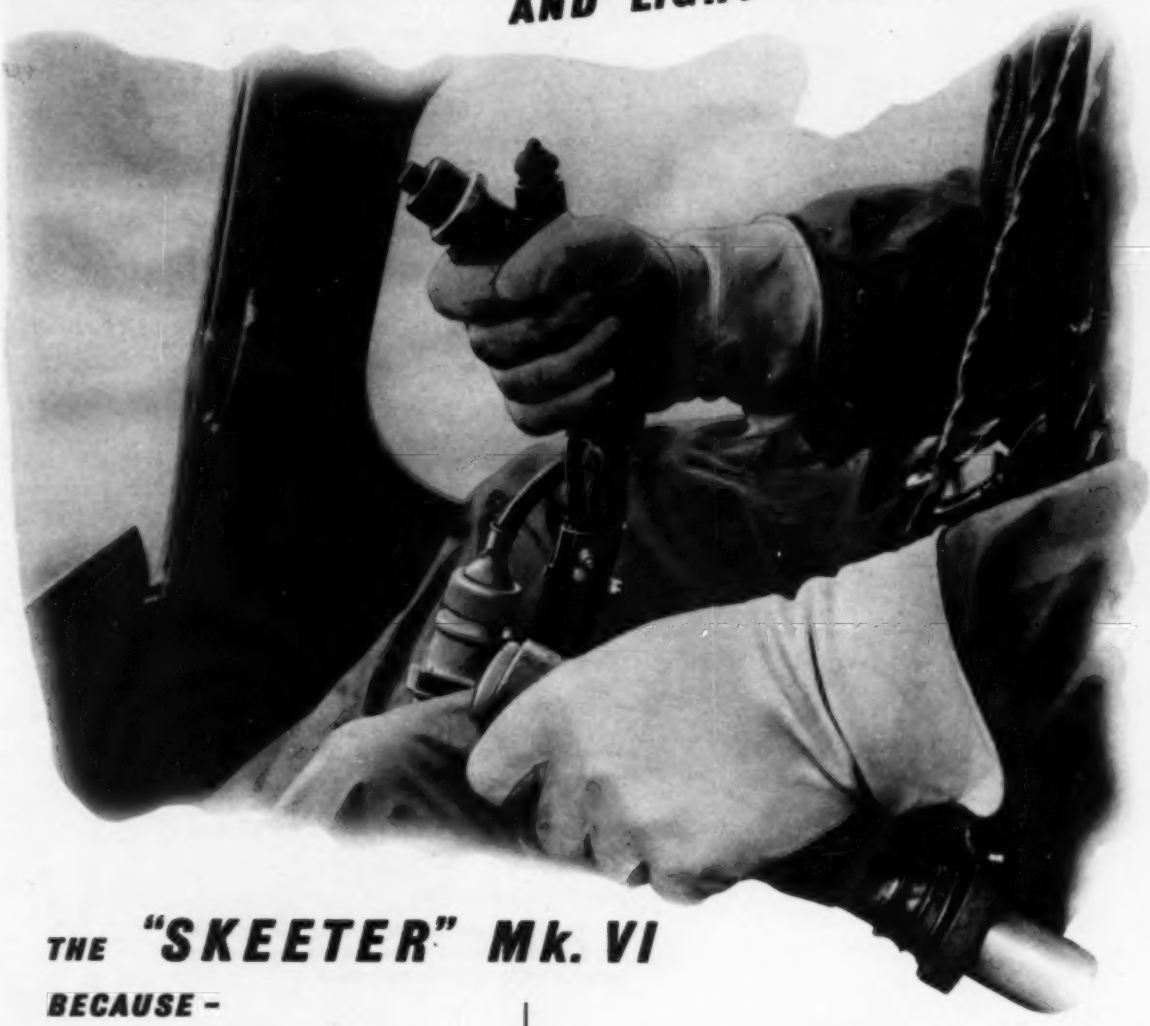
A recent picture of Soviet "Farmer" fighters.

Span, 37ft 1in; length, 42ft 4in; gross weight with external tanks, 20,347 lb; gross weight clean, 18,500 lb; speed, over 650 m.p.h.; combat radius, about 500 miles; service ceiling, over 45,000ft.

North American F-100C Super Sabre The Super Sabre was the first operational aircraft in the world capable of supersonic speed in level or climbing flight. Classed by the U.S.A.F. as a fighter/bomber, the F-100C now forms the equipment of several squadrons and is apparently considered primarily as an attack weapon. It is nevertheless basically a fighter and commands attention under this heading. It differs from the F-100A (still in service, and the subject of a very detailed description in *Flight* of May 20th, 1955) in having a stiffer wing, capable of carrying a great variety of stores and in its provision for in-flight refuelling. Later machines will be adapted for the "buddy" system of air refuelling, which enables one F-100 to take fuel from another of the same type. The buddy aircraft trails a hose and drogue from an external pod under the wing and on completion of refuelling the entire equipment is automatically rehoused within the pod.

The following description applies basically to the F-100A and C. The wing has a leading-edge sweep of 45 deg and incorporates an unusual form of lateral control, the ailerons being mounted well inboard, over the greater part of the trailing edge, in the position normally occupied by the flaps. Thus, with the type of wing chosen, insufficient flap surfaces could be fitted to justify their inclusion at all. In view of this fact it was decided to fit full-span automatic leading-edge slats (not flaps or a drooping leading edge, but true Handley Page slats), and their

UNRIVALLED FOR TRAINING AND LIGHT LIAISON



THE "SKEETER" Mk. VI

BECAUSE –

The handling qualities, due in part to its three-bladed fully articulated rotor, are just those found in the larger types of helicopter. It is not difficult to fly, and the manoeuvrability is exceptional.

The throttle may readily be disconnected from the collective pitch lever, permitting practice autorotative landings without stopping the engine, and the engine may safely be left running on the ground.

The engine of 'One Hour Power' rating gives consistent and undiminished performance.

All maintenance can be done from ground level, except for the main rotor hub which is reached by using footholds on the helicopter structure.

Vision from the cockpit is unusually good, with a wide aspect rearwards.

A manual control of the centrifugal clutch prevents overloading of the rotor system when starting.

These are some of the features of the Skeeter helicopter which commend it for its chosen duties. Each of them contributes towards the economy which is a feature of its initial and operating costs.

SAUNDERS-ROE LIMITED

HEAD OFFICE: OSBORNE · EAST COWES · ISLE OF WIGHT · TEL: COWES 2211
HELICOPTER DIVISION: EASTLEIGH · SOUTHAMPTON · TEL: EASTLEIGH 2731

pioneer designers of the ejection seat

UNPARALLELED ACHIEVEMENTS

Squadron Leader J. F. Fifield, D.F.C., A.F.C., made aviation history when he successfully ejected from a Meteor aircraft at runway level during September and again the following month at an altitude of more than 40,000 feet.

Martin-Baker Fully Automatic Ejection Seats were used for both tests, proving yet again that these seats are undoubtedly the finest in the world of aviation.

NOTE TO AIRCREW:

The Seat used for the runway ejection was fitted with modified time release, not yet incorporated in Service equipment.

MARTIN-BAKER

Saab J29F.

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

incorporation is reported to have given a notable increase in available lift, a decrease in manœuvring drag, and better stability at high lifts. The wing has two root-to-tip spars which, with the immensely thick, screwed-on tapered skin, form a massive box. Each of the ailerons is made in two parts and is fully powered by irreversible jacks. The Pratt and Whitney J57 (P-7, F-21 or F-39) has an afterburner, and takes in air through a distinctive nose intake of roughly oval cross-section, the duct remaining flattened as far back as the leading edge of the wing. Fuel tanks occupy the entire volume under the engine and centre fuselage except for the very bottom which is devoted to wheel stowage and the wing carry-through structure. The fin area was increased as a result of serious aerodynamic trouble experienced in the earlier stages of development, and the slab tailplane is mounted very low on the fuselage. Most of the electronic equipment is housed forward of the cockpit, where cooling is provided by a refrigeration circuit fed from inside the duct.

The built-in armament is four 20 mm M-39 guns having a combined rate of fire well in excess of 6,000 rounds a minute. With only F-100C includes a Minneapolis-Honeywell automatic pilot. With only two auxiliary under-wing tanks (more are possible) the F-100C carries about 1,745 U.S. gallons. Among possible under-wing loads are packs each containing forty-five 2.75in Mighty Mouse rockets.

It was on an F-100C, on August 20 last, that a world's high-altitude supersonic speed record of 822.135 m.p.h. was established at 35,000ft. (This has subsequently been handsomely beaten by the Fairey F.D.2 research aircraft.)

Indicative of the complexity of this massive fighter, which typifies a new generation of single-seaters, is the reported figure of 50 hours of ground work needed for each hour of flight. The corresponding figure for the F-86D, with its all-weather equipment, is given as 46 hours, and for the war-time piston-engined Mustang 13 hours.

Span, 38.78ft; length, 47ft; gross weight, without external stores, 28-29,000 lb; with external stores, over 35,000 lb.

North American F-100D Super Sabre Radar-equipped for all-weather capability, the "Dog" variant of the F-100 is reported (though not confirmed) as having a flap-blowing system utilizing bleed-air from the engine compressor. The makers describe it as "an air-superiority fighter with fighter/bomber capabilities" and claim a service ceiling of over 50,000ft. A probe-and-drogue flight-refuelling system is installed in view of the intended rôles of fighter/bomber or escort fighter, and a Minneapolis Honeywell automatic pilot is standard. Armament is four M-39 guns (20 mm). The first prototype flew on January 24th last and deliveries should be made to the U.S.A.F. during the closing months of this year.

North American F-100F A two-seater development, with "combat and training potential."

Mig-17s.

North American F-107A Originally known as the F-100B, this fighter is an all-weather intercepter, powered with a Pratt and Whitney J75 turbojet of some 15,000 lb static thrust and delivering about 21,000 lb with an afterburner. A special variable-inlet duct embodying a flat shock-forming wedge has been developed for this machine.

Republic F-84F Thunderstreak The Thunderstreak is a fighter/bomber extensively used by the U.S.A.F. and NATO air forces; it is also considered under the heading "Ground Attack." Though incapable of supersonic speed on the level, it achieves a Mach number of 1.175 in the clean condition at a shallow angle of dive. Armament is six 0.5in M-3 Browning-pattern guns. Provision is made for boom-type refuelling, the connection lying under a sliding panel in the port wing. Internal fuel capacity is 570 U.S. gallons, and the maximum fuel weight for ferrying without external war load, is 1,930 gallons, Among advanced aerodynamic and structural features of the later Thunderstreaks is a slab tailplane. With external stores these machines frequently operate at all-up weights of the 25,000-27,000 lb order. The powerplant is an American-built Armstrong Siddeley Sapphire —the Wright J65-W-3 or -W-7 of some 7,200 lb thrust, without afterburner.

Though at one time it was intended to install a built-in liquid-fuel rocket for take-off assistance, this project does not appear to have gone forward, although provision is made for four RATO bottles each of 4,000 lb thrust attached by a "collar" device. A recent fitment is a new type of 16ft braking parachute with a retarding force of 8,000 lb, which is claimed to help the aircraft to stop in 2,400ft. This is about 1,000ft less than the normal landing run.

U.S.A.F. orders for the F-84F, and of its reconnaissance derivative the RF-84F (*q.v.*), were cut by some ten per cent earlier this year "in the light of the availability of more advanced aircraft of the century series."

Span, 33ft 7in; length, 43ft 5in.

Republic XF-103 Very little has been officially disclosed concerning this fighter beyond a recent statement by the Commander of Air Research and Development Command to the effect that "extensive tests" were conducted on the machine during 1955. (Note that no specific reference is made to flying tests). It was added that the XF-103 was originally designed as an all-weather intercepter to accomplish a mission similar to that of the F-102. However, "superior performance estimates, resulting from an advanced design concept," led to a longer development period than that needed for the F-102, and the XF-103 is now being used as an "experimental weapon system." Unofficially it is reported to be powered with a Wright J67 turbojet of 15,000 lb thrust, plus a ramjet using the same airstream. The pilot is able to direct the flow from one engine to the other by means of vanes. A pilot periscope has also been mentioned.

Republic F-105A Precursor of the production type F-105B, this is a fighter/bomber with Pratt and Whitney J57 turbojet. The first prototype (since lost) flew last October.

Republic F-105B Intended as a successor to the F-84F and having a reconnaissance variant in the RF-105B, this development has a Pratt and Whitney J75-P-3 turbojet. Characteristic features are short, thin, swept wings; a long cylindrical area-ruled fuselage; wing-root intakes, permitting radar to be fitted in the pointed nose; and a one-piece flying tail, set low on the fuselage. All internal fuel is carried in the fuselage. A production order has been placed.

Ryan X-13 Reported designations for the direct take-off fighter/research aircraft now under development by Ryan are XF-109, Type 69 and X-13—the last officially confirmed. A delta, it is powered with a British-built Rolls-Royce Avon delivering, it may be supposed, well in excess of 10,000 lb of thrust for take-off, and all-up weight has been reported as 8,000 lb. Preliminary tests are said to have been made with a special undercarriage, permitting near-horizontal landings and take-offs. The X-13 is the subject of a 7 million-dollar U.S.A.F. contract.

FRANCE

Bréguet Taon In view of its primary rôle of tactical support, this light fighter/bomber, to the NATO specification, is dealt with under "Fighter/bombers and Ground Attack."

Marcel Dassault Mystère IIC Dating from 1951, this single-seat intercepter is far advanced in production. After three prototypes came 17 pre-production machines, followed by the main contract for 150, of which 45 had been delivered by February last. The turbojet is a S.N.E.C.M.A. Atar 101D-1 of 6,615 lb thrust. Empty and gross weights are, respectively, 11,510 lb and 16,440 lb, and the armament is two

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

30 mm DEFA guns with radar ranging. Cruising speed is given as 530 m.p.h. and maximum speed as 657 m.p.h. Endurance is 1 hr 30 min, and ceiling 49,000ft.

Marcel Dassault Mystère IVA This version of the Mystère dates from the autumn of 1952 and is powered by a Hispano-Suiza Verdon (Rolls-Royce Tay development) of about 7,700 lb thrust. The prototype was followed by a pre-series of eight machines, and of production orders totalling 325, some 128 had been delivered by March this year. A small batch has been supplied to Israel. Armament is as for the Mystère IIC, and gross and empty weights are 16,530 lb and 12,950 lb. Cruising and top speeds are quoted as 596 m.p.h. and 696 m.p.h., and supersonic speed is attained in the dive. Initial rate of climb is nearly 8,900 ft/min and ceiling 54,130ft.

Span, 36ft 6in; length, 42ft 2in.

Marcel Dassault Mystère IVB This variant is powered with a Rolls-Royce Avon RA.7R or S.N.E.C.M.A. Atar 101G, both with reheat. The first prototype flew in December 1953, and about three months later achieved supersonic speed in level flight. Compared with the Mystère IVA the "B" has a redesigned forward and rear fuselage, the air duct passing beneath the pilot's cockpit instead of being divided to pass on either side, and the rear portion being adapted to take the afterburner.

Marcel Dassault Super Mystère B.2 (Mystère IVB.2) The first Super Mystère was the B.1, powered with a Rolls-Royce Avon RA.7R, which first flew in March 1955 and achieved supersonic speed in level flight on the same day. The B.2 is powered by the S.N.E.C.M.A. Atar 101G-1 turbojet (9,700 lb thrust with afterburner) and has a 45 degree swept wing (a 7 degree increase compared with that of the Mystère IV B). Two prototypes and five pre-production aircraft were ordered and contracts from the French Government total 150, which figure is to be increased to 370. Deliveries will begin in 1957. Empty and gross weights are 15,400 lb and 19,800 lb. Ceiling is given as 55,750ft. Built-in armament is two 30 mm DEFA guns, and there is provision for 35 Matra folding-fin air-to-air or air-to-ground rockets in a retractable ventral tray.

Marcel Dassault Mirage Bearing the type number M.D.550, two prototypes of this mixed-power delta-wing fighter are in existence and three others, incorporating improvements, are under construction. The first machine flew in June 1955, powered with two Marcel Dassault M.D.30 Viper turbojets. The SEPR rocket, which is to form the main powerplant, was being installed during March this year after initial tests with the turbojet alone. Design Mach number is reported to be 1.7.

Marcel Dassault Mystère 22 An intercepter and tactical support aircraft built to a French Air Force specification, powered by two Turbomeca Gabizo turbojets totalling just under 5,000 lb thrust. A second machine may have two S.N.E.C.M.A. Vestas. Span is about 26ft and the thickness/chord ratio 6 per cent. A retractable launching tray for air-to-air missiles may be fitted in addition to two 30 mm guns, each with 120 rounds. All-up weight is thought to be about 11,000 lb.

Marcel Dassault Mystère 24 Cavalier Similar to the Mystère 22, but powered by a single S.N.E.C.M.A. Atar 101G turbojet of 9,700 lb thrust with afterburner. A prototype is nearing completion.

Marcel Dassault Mystère 26 Again, a similar machine to the Mystère 22, but adapted to take a single Bristol Orpheus. Three prototypes are being built.

Leduc 022 Two prototypes of this supersonic intercepter are being built. The key design feature is the Leduc ramjet, reported to be capable of delivering over 140,000 lb thrust at a Mach number of 2 and built round a centrally installed S.N.E.C.M.A. Atar 101 turbojet, on the thrust of which the 022 will take off. The Atar will serve also for cruising and landing. An average rate of climb of over 20,000ft/min should be sustained to the ceiling—far in excess of 70,000ft. Guided missiles are the likely main armament. The moderately swept wing is of integral contruction and will contain a useful quantity of fuel.

Nord/S.F.E.C.M.A.S. Gerfaut I A detailed illustrated account of this unusually interesting delta-wing fighter prototype appeared in *Flight* of April 13 last.

Nord/S.F.E.C.M.A.S. Gerfaut II The first flight of this developed Gerfaut, the essential features of which are apparent in a picture on an earlier page, took place on April 17 last, and less than a month later the machine had been handed over to the C.E.V. (official flight-test centre). Numerous supersonic flights have been made and rate of climb and high-speed handling are described as "exceptional."

(Left) Hawker Sea Hawk.

Vickers-Supermarine N.113.

Chance Vought F8U-1 Crusader.

Nord 1500 Griffon Formerly known as the Guepard, the prototype of this exceedingly interesting delta-wing canard (tail-first) missile-armed intercepter was first flown on September 1, 1955. As on the Gerfaut, there is a straight-through duct to the Atar turbojet but the cockpit is far forward. When the new fighter was introduced it was remarked in *Flight*, "The moving forward of the cockpit would help the air intake at high angles of attack. The forward trim plane is in keeping with the latest thought on supersonic flight. Its great advantage is that, as the centre of pressure moves aft at the speed of sound, so the nose plane can be used to lift the nose instead of depress the tail—thereby adding, instead of subtracting, lift at a critical time when there is a loss of C_L. Furthermore, at low speeds there is no danger of a nose plane being blanketed by the wing.

"The proportions of the Griffon's fuselage and jet orifice suggest that the afterburner is a major item in the powerplant complex—perhaps more in the nature of a 'turbo-ramjet.' Although the engine-duct centre-line coincides with the wing chord line it is probably a clean-run circular duct, with the wing loads carried round the fuselage by banjo frames as in the earlier aircraft. The main body probably contains most of the fuel as well as the engine duct."

S.N.C.A.S.E.212 Durandal First flown on April 20 last, this delta-wing supersonic intercepter is powered with an Atar 101G delivering about 9,700 lb with afterburner, and with an SEPR liquid-fuel rocket. Its characteristics are shown by a photograph on an earlier page.

S.N.C.A.S.O.9050 Trident II This is thought to be an operational version of the S.O.9000 Trident I fighter/research aircraft of which two prototypes were built, the first having taken the air on March 2, 1953. The design is unconventional in almost every respect, the wing, for example, being straight, untapered and of low aspect ratio, and the horizontal "slab" tail surfaces being low-set and having a marked anhedral angle. Trefoil air brakes are mounted far aft and the undercarriage retracts into the fuselage. The Trident II is of the so-called "mixed-power" class, having two Marcel Dassault M.D.30 turbojets (Armstrong Siddeley Viper licence) mounted at the wing tips and an SEPR four-barrel rocket motor in the tail. The M.D.30s each deliver about 1,690 lb thrust and the rocket a total of 11,000-12,000 lb. The Vipers are likely to be replaced by Turboméca Gabizos, each of over 2,400 lb thrust. Of the two prototypes ordered by the French Government the first flew in July last year. Already there is a report of a Trident III.

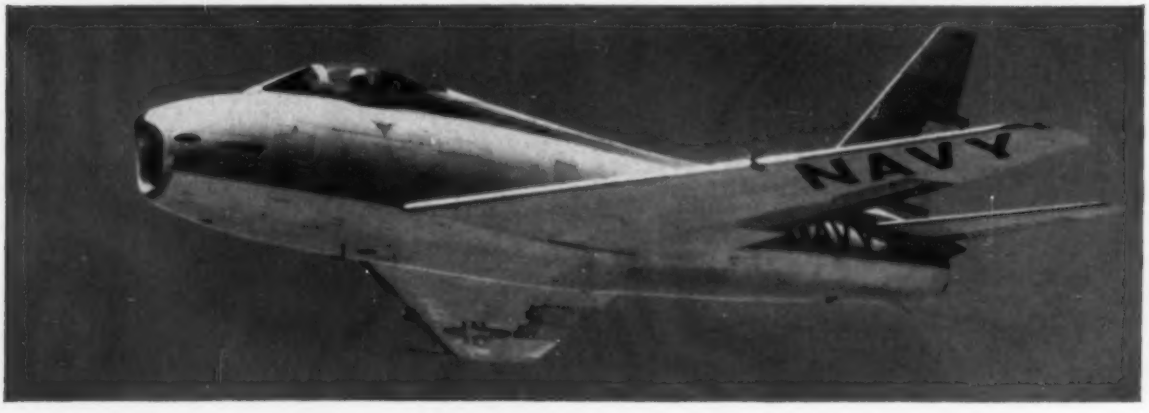
The Trident II is said to have a Mach number of 1.6 or higher and is certainly among the fastest-climbing fighters in the world. Missile armament is specified, but it is not yet clear how this is to be disposed. Gross weight is probably in excess of 13,000 lb and span about 28ft.

U.S.S.R.

Mig-15 Bearing the Allied code-name Fagot, the Mig-15 and Mig-15*bis* (the latter being an improvement of the original type) continue in extensive service with Russian formations and with satellite air forces. Fighters of the same type have been exported to Egypt. The essential characteristics have long been familiar but these points may be reiterated: the aircraft is of comparatively light weight, normally totalling little more than 11,000 lb but capable of operating, with external tanks, at weights in excess of 14,000 lb. Supersonic speed is not attainable, either on the level or in a dive. Initial rate of climb is in excess of 10,000ft/min and service ceiling over 50,000ft. Armament is two 23 mm guns and one 37 mm gun, mounted as a readily removable pack. The turbojet is of a very highly developed Rolls-Royce Nene type without any form of power boosting.

Span, 33ft; length, 36ft 4in.

North American FJ-4 Fury.



MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, LAND-BASED

Mig-17 Known in the Allied nomenclature code as the Fresco, this is a somewhat larger machine than the Mig-15, of which it is a development, having a span of 36ft. The wing is of entirely different plan-form and more heavily swept. Air brakes are positioned far to the rear (as on the Mig-15) but are of modified pattern. A small strake extends for a short distance under the rear fuselage. All-round performance is higher than that of the Mig-15, although the turbojet is thought to be of the same general (Nene-development) type.

"Farmer" The latest type of single-seat day fighter known to be in service with Russian formations has the Allied code-name Farmer. It bears a certain superficial resemblance to the French Super Mystère but the wing is mounted relatively high on the fuselage. Supersonic speed should be attainable in level flight. Some 50 of these machines took part in the 1955 Aviation Day fly-past.

A point of particular interest (in which this fighter resembles the Mystère 22 and Bréguet Taon rather than the Super Mystère) is the provision of twin jet-pipes. Whether these signify dual power units cannot, for the moment, be determined. The tailplane follows the general plan of the wing, is low-mounted, and possibly of the "slab" type.

SWEDEN

Saab J29F The "F" sub-type of the familiar J29 "flying barrel" has been built both on an *ab initio* basis and as a conversion of earlier variants. The lightened outer wings have the now-fashionable "saw-tooth" leading edge, which enhances manœuvrability at high speed and is said to improve critical Mach number also. The Swedish-built de Havilland Ghost 50 turbojet, normally delivering 5,000 lb thrust, is fitted with an afterburner, which increases its output to something like 6,500 lb and approximately doubles the initial rate of climb and improves service ceiling. Armament is four 20 mm Bofors-built guns. Maximum speed is of the order of 660 m.p.h. and gross weight 13,600 lb.

Saab J35 Draken A remarkable fighter is this "double delta," built following extensive experience with the Saab 210 research aircraft. The peculiar plan-form is claimed by the makers to provide a relatively large space for equipment and fuel, in combination with low weight, low drag, supersonic speed and a high degree of intake efficiency. The power unit is a Rolls-Royce Avon with afterburner, built in Sweden by Svenska Flygmotor. The main undercarriage legs have pre-retraction and a braking parachute is contained beneath the delta form fin. Provision is believed to be made for 30 mm guns in addition to rocket projectiles or air-to-air guided weapons, and electronic equipment is said to allow "all-weather navigation and flying at very high altitudes." It is intended that Drakens will eventually be issued to squadrons at present equipped with J29s and Hawker Hunters.

ITALY

Aerfer Ariete A joint project by the U.S. Government and the Italian Air Ministry, the Ariete is a development of the Ambrosini Sagittario, having a Rolls-Royce Derwent turbojet developed with a "hot" turbine and special combustion system to increase thrust to over 4,500 lb. Auxiliary—and cruising—thrust is supplied by a Rolls-Royce Soar turbojet, or a liquid-fuel rocket can be fitted instead. One design study incorporating the latter powerplant is said to call for a Bristol Orpheus as the turbojet. Span is reported to be about 24ft and the armament is likely to be two 30 mm guns. Three prototypes are under construction at a cost of some 2.3 million dollars.

Chance Vought F7U-3M Cutlass.

(Below) Grumman F11F-1 Tiger.

FASTEST · FARTHEST · HIGHEST

V

for **VICTOR**

Surpassing the most stringent operational requirements, the four-jet crescent-winged Victor is Britain's premier bomber.

HANDLEY PAGE · *RADLETT · LONDON · READING*

"Gentlemen, no adhesive problem has ever beaten Bostik..."

If the BOSTIK people haven't the right answer to your sealing or adhesive problem at their finger tips, their research laboratory (finest of its kind anywhere!) soon will have! BOSTIK Products have solved problems from arctic to equator and from stratosphere to sea-bed. Call in a BOSTIK man at the start of your projects and have the advantage of the most up-to-date adhesive techniques and the finest system of adhesion in the world.

CALL IN

Bostik

AT THE DESIGN STAGE

Makers of: Rubber/Resin Cements—inflammable and non-inflammable · Spray applied plastic coating compositions Synthetic rubber/resin cements · Latex rubber/resin adhesives · Resin cements · Self-curing natural and synthetic rubber cements · Natural and synthetic rubber solutions · Natural and synthetic rubber latex cements · Bituminous compounds for sound deadening, sealing and coating · Heat curing plastic sealers · Extruded plastic strip Adhesives and sealing compounds resistant to high and low temperatures, oil, petrol and kerosene, acids and alkalis Cements to a variety of Admiralty and Ministry of Supply specifications.

BOSTIK is a registered trademark of B. B. CHEMICAL COMPANY LIMITED, ULVERSCROFT ROAD, LEICESTER

Douglas F4D-1 Skyray.

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, SHIP-BASED

GREAT BRITAIN

Folland Sea Gnat It was announced in April this year that the Royal Canadian and United States Navies had expressed interest in a carrier-borne version of the Gnat, known as the Sea Gnat. In naval service this tiny fighter would have the advantage that fourteen could be stored in the space occupied by five "standard" naval fighters. Endurance with internal fuel only is an hour, or with auxiliary tanks, two hours.

Hawker Sea Hawk. This Nene-powered fighter/bomber continues in service with the Fleet Air Arm in its Mks. FB.3 and FGA.4 forms. Built-in armament is four 20 mm British-Hispano guns.

Vickers-Supermarine N.113 This massive single-seater will succeed the Sea Hawk as the standard fighter/bomber of the Fleet Air Arm and production is already well advanced. In essentials the machine resembles its forerunner, the Type 525, but has a longer, pointed, nose and—apparently—intakes of increased area. The latter suggest that the two laterally disposed Rolls-Royce Avon turbojets are of higher thrust than formerly. There is no evidence of afterburning. Design features include a saw-tooth leading edge and an all-moving tail. Of particular interest is the "super-circulation" system whereby air ducted from the Avon compressors is blown over the upper surfaces of the flaps to increase lift by local acceleration of the air-flow.

It was disclosed in March this year that, although the first service version of the N.113 was originally intended to be armed with guided weapons as well as with guns, it had not proved possible to accommodate both types of armament without rendering the aircraft too heavy for carrier operation. In consequence, the first mark will be armed with four 30 mm Aden guns. Investigations into the possibility of arming a later version with guided weapons as an alternative to the guns are proceeding.

U.S.A.

Convair XFY-1 Pogo Although development of the Lockheed XFV-1 Salmon vertical take-off turboprop fighter has been abandoned, the generally similar Convair machine, designated XFY-1, is still the subject of U.S. Navy experiments. For this reason the present section is headed "ship-based" rather than "carrier-borne," for such machines as the Pogo (as the XFY-1 is named) could operate from the decks of comparatively small ships. Nevertheless, it appears improbable that turboprop fighters of this type will ever see service, for the turbojet now bids fair to dominate the entire v.t.o. fighter field.

The XFY-1 has an Allison YT40-A-14 turboprop driving a 16ft Curtiss-Wright contra-rotating airscrew. In consideration of the take-off and landing attitude the pilot's seat is gimbal-mounted.

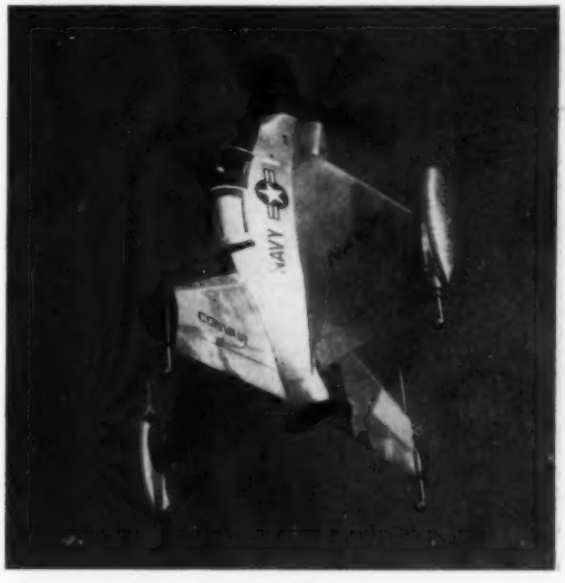
Douglas F4D-2N Skyray Although the F4D-1 day fighter version of the Skyray was built in small numbers, quantity production is at present concentrated on the F4D-2N, equipped with all-weather radar and fire control.

The design principles of the Skyray (delta wing of low aspect ratio; rounded wing-tips and swept-back trailing edge; no horizontal tail surfaces) are already well known. Mounted on the trailing edge are elevon and trimmer surfaces, and air brakes—four in number—are paired on upper and lower surfaces. The outer wing sections of the 33ft 6in wing fold upward for stowage.

It would appear that the advanced design of the Skyray has brought with it peculiar problems, and carrier qualification trials undertaken last autumn are reported to have been unsuccessful. Lately, however, trials have been satisfactorily concluded.

Built-in armament is four 20 mm guns, and for this the Aero 13F intercepter fire-control system is being introduced. Further development will integrate an automatic flight control system into the fire control unit so that automatic tracking and firing will be possible, Supplementary under-wing armament can be six packages each containing seven 2¾in air-to-air rocket projectiles or four packages each with 19 projectiles. Alternatively, the wing strong-points can be occupied by two 150 U.S. gallon or two 300 U.S. gallon fuel tanks.

The fully powered controls have two independent hydraulic systems



Convair XFY-1 Pogo.

Grumman F9F-8 Cougar.

McDonnell F3H-2N Demon.

MILITARY AIRCRAFT 1956

Fighters

SINGLE-SEAT, SHIP-BASED

and direct manual control is possible in the event of engine failure or of the failure of both systems. The engine is a Pratt and Whitney J57 with afterburner, giving supersonic speed in level flight and an extremely high rate of climb. On at least one occasion a Skyray has ascended to 10,000ft from a standing start in 53 seconds. The machine is further reported to be able to climb to 40,000ft in less than 5 minutes and at that altitude to be capable of 5 minutes of combat at maximum thrust. Ceiling is over 55,000ft.

Span, 34ft; length, 45ft 8in; gross weight, over 20,000 lb.

Douglas F5D A development of the F4D, this is now on test. The turbojet is a General Electric J79 and the fin is enlarged.

Grumman F9F-8 Cougar The F9F-8 may be the last single-seat fighter variant of the Cougar, itself a development of the straight-wing Panther. Though powered, as was the F9F-6, with a Pratt and Whitney J48-P-8 (Rolls-Royce Tay licence), it is considerably faster, more manœuvrable and has a longer range. The improved performance has been achieved by modifying the leading and trailing edges of the wings and lengthening the fuselage. The movable wing slat has been replaced by a fixed cambered leading edge and the trailing edge extended, increasing the chord by 15 per cent, and these modifications between them have improved not only the high-speed but the low-speed characteristics also. Larger wing area is said to benefit manœuvrability and low-speed handling and the makers claim that twice as much g can be pulled at high altitude as was possible with the F9F-6. Lengthening the centre portion of the fuselage by 8in has made room for 80 U.S. gallons of additional fuel and another 30 gallons have been disposed in the wing in place of the hydraulic system for the leading-edge slats. Gross weight is about 20,000 lb, speed some 700 m.p.h., and time of climb to 40,000ft about 7 minutes. Armament is four 20 mm guns.

Span, 34ft 6in; length, 41ft 7in.

Grumman F11F-1 Tiger Designed as a comparatively light supersonic air-superiority fighter for the U.S. Navy, the first prototype of the Tiger was first flown in July 1954—fifteen months after the design had been approved. It was among the first fighters to incorporate the principle of area rule and this, in conjunction with the relatively small size and the high thrust of the afterburning Wright J65-W-6 (Armstrong Siddeley Sapphire) allows level-flight Mach numbers well in excess of unity. Lateral control is provided by large spoilers, working in conjunction with small tip ailerons. The structure is simple and modern, the entire top and bottom sections of the wing being machined from single sheets of aluminium alloy, forming integral fuel tanks. Weight and complication has been saved by adopting manually folding wing-tips. Gun armament is 4×20 mm and provision will be made in operational variants for air-to-air guided missiles. These will doubtless raise the gross weight above the reported figure of 13,850 lb.

It would appear that development of the Tiger has not run altogether smoothly and various modifications, including a new tail unit, with reduced taper ratio, and revised wing fences, have been incorporated.

Span, 31ft 8in; length, 40ft 10in.

McDonnell Banshee The Banshee is no longer in production but the F2H-3 and F2H-4 warrant reference in being long-range all-weather single-seaters having search radar and probe/drogue flight-refuelling equipment. Both models have been delivered in quantity to the U.S. Navy and Marine Corps, and -3s are serving with the Royal Canadian Navy. Gross weight is over 19,000 lb and speed slightly greater than 600 m.p.h. Armament is four 20 mm guns and the powerplant two Westinghouse J34-WE-38s. Normal range, with tip tanks, is of the uncommonly high order of 2,000 statute miles.

McDonnell F3H-2N Demon Though the development of the Demon has been fraught with difficulties and disappointments (mostly associated with the powerplant) the -2N variant has taken up its duties as an operational aircraft with the United States Fleet. The fastest all-weather fighter now in Navy service, it is powered with an Allison J71-A-2 delivering over 14,000 lb with afterburner, and has a gross weight of some 30,000 lb. The wing is of comparatively generous area, swept at about 40 deg. and carries power-actuated leading-edge slats and trailing-edge slotted flaps. The air brakes are mounted laterally and the slab tailplane is mounted on the curious form of beaver-tail termination of the fuselage. Four 20 mm guns fire through ports in a "chin" substructure.

Span, 35ft 4in; length, 47ft 6in.

McDonnell F3H-2M Demon This is a missile-carrying version of the Demon and recently underwent U.S. Navy evaluation tests. An unspecified number of missiles are carried beneath the wing, and are additional to the four 20 mm guns. Production is well advanced and -2M Demons share with the -2N version a recent additional order.

McDonnell F4H-1 A reported development of the F3H, formerly designated AH-1, arranged as a two-seater, having a new type of powerplant and no gun armament.

North American FJ-4 Fury The Fury is a naval development of the Sabre, and the -4 variant, carrier trials of which were recently put in hand, is the latest of the production series. It follows the FJ-2 and FJ-3, which, in turn, were descended from the straight-wing FJ-1, the first of the family to go into naval service. In essentials, however, it is an entirely new design. Powered with a Curtiss-Wright J65-W-16 turbojet (Armstrong Siddeley Sapphire) of 7,800 lb thrust, it is faster than any of its predecessors, weighs over 19,000 lb, has a speed (according to a U.S. Navy approved statement) of "over 600 knots," and a service ceiling higher than 45,000ft.

Of the new features embodied in the -4 the most significant is the larger, thinner wing adopted to increase speed, improve altitude and extend range (by housing more internal fuel). This is of multi-spar type, with machined skin. The leading-edge flaps are of large chord and droop automatically, and the flaps and ailerons are mounted well inboard of the tips. The fuselage is deeper than on the earlier Furies and has a dorsal spine, and the undercarriage is similar in principle to that of the F-100. Titanium is used extensively. The all-moving tail surfaces are mounted as on the Sabre, but the vertical tail surfaces are increased in height. Armament is four 20 mm guns.

Span, 39ft 1in; length, 36ft 5in.

Chance Vought F7U-3M Cutlass Production of the Cutlass has now ceased, but the -3M variant merits mention, being the first guided-missile carrier to enter service with the U.S. Navy. The missiles—four Sperry Sparrow Is, each about 12ft long and weighing some 300 lb—are carried on toed-in under-wing launchers. The weapons system, according to an official announcement, "permits effective attacks against high- and low-altitude targets, flying either singly or in groups."

The Cutlass airframe is remarkable in that there are no horizontal tail surfaces. Very tall fins and rudders stem from the trailing edge of the wing and the broad rear fuselage houses the afterburners for the Westinghouse J46-WE-8A turbojets. A General Electric flight stabilization system corrects for yaw and pitch oscillations, slips and skids. Empty weight is about 18,000 lb and gross weight about 32,000 lb. Rate of climb has been claimed as 13,000 ft/min and the Cutlass can launch "any modern weapon" at speeds in excess of Mach 1.

Span, 38ft 8in; length, 44ft 3in.

Chance Vought F8U-1 Crusader Perhaps the most remarkable carrier-borne fighter now flying, the Crusader was the subject, last December, of a U.S. Navy order totalling $100 million. Some three months later came a second contract, amounting to $45 million.

Armstrong Whitworth (Gloster) Meteor N.F.14.

Gloster Javelin FAW.4.

The Crusader was designed as a supersonic day fighter to achieve air superiority, and exceeded Mach 1 on its first flight. The very thin, swept wings are mounted in the shoulder position, have saw-tooth leading edges on their outboard portions and—unique among fighters—are variable in incidence. The leading edges droop and the outer panels fold upwards for carrier stowage. The wing itself is of about 5 per cent thickness ratio and has mid-span ailerons. The Pratt and Whitney J57-P-12 turbojet, with afterburner, takes in air through a double-shock "beard" intake, initially flattened, then rising and expanding in section, and the engine/duct combination is stated to be stall-free and to give controlled airflow without the complication of a variable inlet structure. A Marquardt ram-air emergency power package supplies electrical and hydraulic power to maintain control and communications in emergency (i.e., flame-out or failure of main alternator). Fuel tanks of various shapes and sizes are disposed at several points in the fuselage. Titanium is used extensively in the rear and midships fuselage structure and additional weight is saved by the use of a lightweight (30 lb) ejector seat—an adaptation of that designed for the Douglas Skyhawk light attack bomber. The undercarriage retracts into the fuselage. Initial armament is four 20 mm guns but guided missiles will eventually be adopted. Speeds in excess of 1,000 m.p.h. are said to have been attained by the prototype and ceiling is far above 50,000ft.

A version of the Crusader may be supplied to the U.S.A.F.

Span, 32ft 6in; length, 50ft; gross weight, over 22,000 lb.

FRANCE

S.N.C.A.S.E. Aquilon (Single-seater) The third order placed on behalf of the French Navy for the Aquilon (French-developed de Havilland Sea Venom) calls for 40 machines arranged as single-seaters. The powerplant, as in the two-seater, is the Fiat-built de Havilland Ghost 48 Mk. 1.

SINGLE-SEAT, WATER-BASED

U.S.A.

Convair F2Y-1 Sea Dart Though the limited-production contracts once in hand for this water-based fighter have now been cancelled, and development is proceeding only at low priority, the Sea Dart merits reference as the sole example extant of the water-based fighter. The only machine now serviceable is the original XF2Y-1, the second—the YF2Y-1—having been destroyed in an accident and other completed specimens stored. In recent months experiments have been under way with a single hydroski instead of the former double-ski arrangement. A new oleo system is said to reduce the "severe vibration" of the double ski system.

The Sea Dart became the first water-based aircraft to exceed Mach 1, which it did in a dive in August 1954, and though now considered by the makers solely as a research vehicle for hydrodynamic purposes, it is said to have proved quite definitely the practicability of water-basing a supersonic aircraft. A point of interest is that the XF2Y-1 has been using a 400ft L.S.D. (landing ship dock) as a mother ship.

MULTI-SEAT, LAND-BASED

GREAT BRITAIN

Armstrong Whitworth (Gloster) N.F.14 A standard R.A.F. night fighter until the Gloster Javelin can be introduced, the N.F.14 dates from 1953 and incorporates a clear-view cockpit enclosure. Standard armament is four 20 mm wing-mounted guns, but Meteor night fighters have been used experimentally for the launching of guided missiles, carried at the wing-tips. French, Belgian and Danish squadrons, as well as units of the R.A.F., have been equipped with "N.F." Meteors.

Span, 43ft; length, 49ft 11in; gross weight, about 20,000 lb; max. speed, 590 m.p.h.

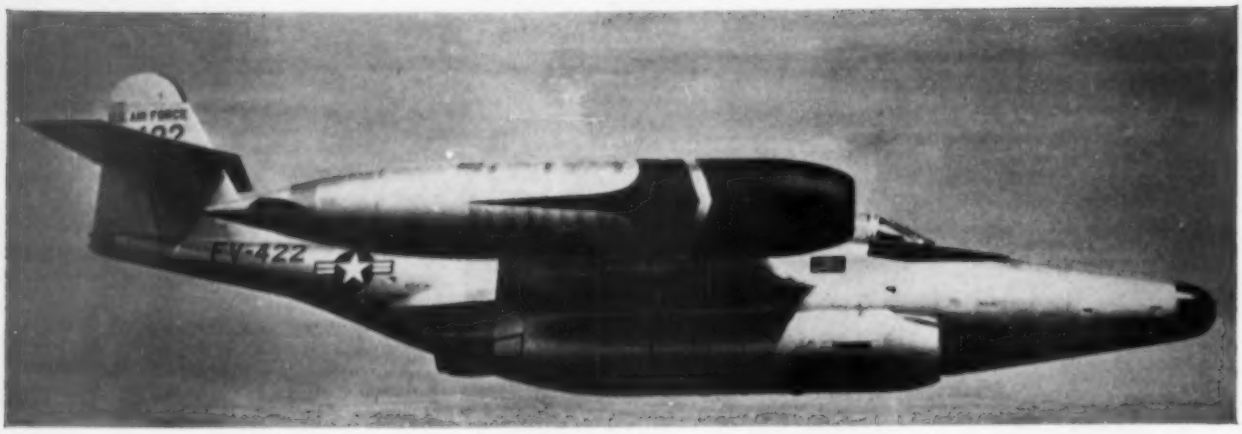
de Havilland Venom N.F.3 Side-by-side-seater Venom night fighters have been supplied to the R.A.F. and the Royal Swedish Air Force. The N.F.3, the latest R.A.F. variant, has improved flying controls, a more modern radar installation than the N.F.2, and a clear-vision cockpit canopy. The Ghost turbojet is of a late mark. Armament is four 20 mm guns.

Span, 41ft 9in; length, 35ft 3in.

Gloster Javelin FAW.1, 2, 4 and 7 Since the original prototype of the Javelin all-weather fighter flew for the first time in November 1951, mention of only one variant—the FAW.1—was, until recently, permissible. Reference may now be made to the Mks 2, 4, and 7, the 2 and 4 being superficially similar to the 1, and the 7 apparently having Armstrong Siddeley Sapphires of increased (possibly five-figure) thrust.

Avro Aircraft CF-100 Mk 5.

Avro Aircraft CF-100 Mk 4.



Northrop F-89D Scorpion.

MILITARY AIRCRAFT 1956

Fighters

MULTI-SEAT, LAND-BASED

All marks now incorporate the so-called pen-nib tail fairing over the twin jet-pipes to extend the buffet boundary.

Deliveries of early-mark Javelins have been under way for some months and the type will be established in squadron service with the R.A.F. this year.

In presenting the Air Estimates during March the Secretary of State for Air said that for all-weather protection reliance was being placed on the Javelin. Though the delay in its appearance in squadron service was to be regretted, the situation was that "more powerful marks" would be delivered into squadron service in greater numbers than expected. R.A.F. production is backed by a joint Javelin/Hunter offshore procurement order valued at $103 million.

In reply to criticisms last year these answers were made on the makers' behalf: "Javelin performance in almost all respects is better than original design expectations, and this includes speed, take-off, landing and high Mach number performance. . . There is no 'mysterious vice' at critical height or speed. . . The record of Javelin crashes, of which there have been three, compares favourably with that of other high-speed aircraft, both British and American. Aerodynamic reasons for two of the three crashes are fully understood. The reasons for the third crash are also understood and they are not aerodynamic."

Though internal fuel capacity of the Javelin may be of the order of 1,000 gallons, two large auxiliary tanks can be attached beneath the turbojets. Built-in armament of the first marks is four 30 mm Aden guns, mounted in the wings, but it has been officially stated that the type is intended "to carry in due course the second generation of British air-to-air guided missile." Mach 1 can be exceeded in a dive and with early Sapphires a great number of flights were made at heights in excess of 50,000ft. Manœuvrability benefits from the low wing-loading and from interconnection of the variable-incidence tailplane and elevators. The Javelin also profits from the fitting of wing flaps. Other features include powered elevator, wing-mounted air brakes, Martin-Baker fully automatic ejector seats, and Maxaret wheel brakes. Experiments have been made with flight refuelling from a Canberra, the Javelin's probe being in the leading edge of the starboard wing.

A makers' publication pointed out earlier this year that alterations in the cabin provided a fair example of the changed aspect since the early project stage. "At that time," it was remarked, "it was essential for the radar observer to be almost in darkness to read his screen easily; now he must be given the utmost possible vision, a major modification occupying many hours of meetings, mock-ups, and trial installations, and reflected in unavoidable delays before the aircraft eventually entered the Service."

Span, 52ft; length, 57ft.

Gloster Javelin Development Eighteen pre-production examples of a later development of the Javelin were put in hand early in 1955. Two Bristol Olympus two-spool turbojets will be fitted and the new machine will carry "a still more advanced electronic and guided-weapons system" than the present Javelin. The wing will certainly be thinner and possibly increased in span.

Hawker Hunter Two-Seater Although apparently built primarily as a trainer, this machine is intended by the makers "to open up opportunities for even wider tactical roles," and it may be supposed that a two-seater all-weather fighter version is in prospect. The prototype now flying has two 30 mm Aden guns.

"Flashlight."

CANADA

Avro Aircraft CF-100 Mk 4B This fourth mark of the CF-100 has been in service for about two years and is distinguished by the installation of two Orenda 11 turbojets of over 7,000 lb thrust each; a lengthened fuselage; Hughes MG-2 fire-control system for radar interception, lead-collision and automatic triggering; a ventral pack of eight 0.5in Browning guns or forty-eight 2.75in Mighty Mouse rockets; and provision for wing-tip, frangible-nose, jettisonable rocket packs, each containing 29 Mighty Mice. Though at one time intended to carry the Canadian-developed Velvet Glove air-to-air guided missile, the Mk 4, or later variants of the CF-100, is now foreseen as a vehicle for the Sperry Sparrow, adopted in place of Velvet Glove and to be made by three Canadian firms on behalf of the R.C.A.F.

The wing-tip rocket packs can be replaced by auxiliary fuel tanks holding a total of about 600 gallons, and these, in conjunction with the internal fuel supply, give transatlantic range. Electric de-icer boots are fitted on all leading edges and are triggered by an ice detector. Free-turning vanes in the intakes are the means of spraying de-icing fluid.

A Minneapolis-Honeywell automatic pilot is standard equipment and can be used in all phases of flight except take-off or flare-out. It is available to the pilot immediately after the aircraft leaves the ground and is designed for use in conjunction with the radar-controlled lead-collision system.

Empty weight of the CF-100 is some 24,500 lb and gross weight about 38,000 lb. Ceiling exceeds 45,000ft and level-flight Mach number is believed to be well in excess of 0.85.

By September last year nine squadrons were operating in Canada and additional squadrons are now being assigned to the Canadian Air Division of NATO in Europe.

Span, 53ft 7in; length 54ft 2in.

Avro Aircraft CF-100 Mk. 5 Already in production, this development has wings extended by some 6ft in overall span and a modified tailplane, likewise of greater span.

Avro Aircraft CF-105 Now under construction are prototypes of this Mach 2 delta-wing, two-seat, all-weather fighter, to be powered by two Orenda P.S.13 turbojets (each of 25,000 lb thrust with afterburning) and weighing some 60,000 lb. The first example should fly next year. A "virtually automatic" interception procedure is in view for this fighter.

U.S.A.

Lockheed F-94C Starfire Although it passed out of production in 1954, the Starfire remains as a standard all-weather two-seater intercepter of the U.S.A.F., and salient facts may be recapitulated. It has a single Pratt and Whitney J48-P-5 turbojet with afterburner, and an all-rocket armament. In the nose is a ring of firing tubes containing 24 Mighty Mouse air-to-air r.p.s., and outboard, on the wing leading edges, can be mounted two pods about 6ft long, each containing 12 additional rockets. The radar and Hughes E.5 fire-control gear weighs some 1,400 lb and the aircraft itself grosses about 27,000 lb. Equipment includes a Westinghouse autopilot, Sperry Zero Reader and I.L.S.

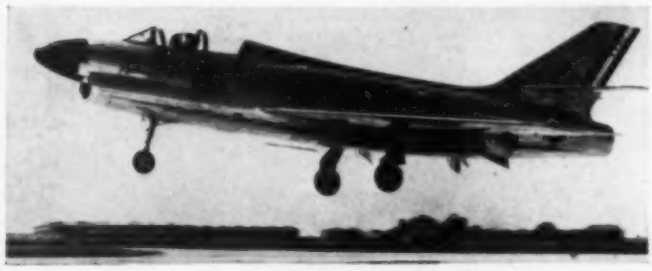
A version has been developed to carry four Hughes Falcon missiles.

Span, 37ft 4in; length, 44ft 6in.

Lockheed F-104B The "B" variant of the F-104 is a two-seat "tactical fighter" and is already in production—a point of special interest, having regard to the U.S.A.F.'s alienation from two-seaters in recent years. Lockheed Aircraft have built, with their own money, a two-seat prototype to serve both for this machine and for a forthcoming trainer.

Northrop F-89D Scorpion Extensively in service, the F-89D is a rocket-armed version of the Scorpion, powered by two Allison J35-A-35 turbojets with Solar afterburners. Earlier variants were armed with six 20 mm guns, but the "D" carries instead a total of 104 Mighty Mouse folding-fin rockets having a muzzle energy totalling 187,200,000 ft-lb when fired in salvo. They are housed in two enormous wing-tip pods, fixed in position, and are electronically aimed and automatically triggered by the Hughes E.6 fire-control gear. Advantages claimed for the wing-tip podding are that the firing of the rockets does not interfere with the crew's vision and that the engine/air intakes are not exposed to smoke and debris.

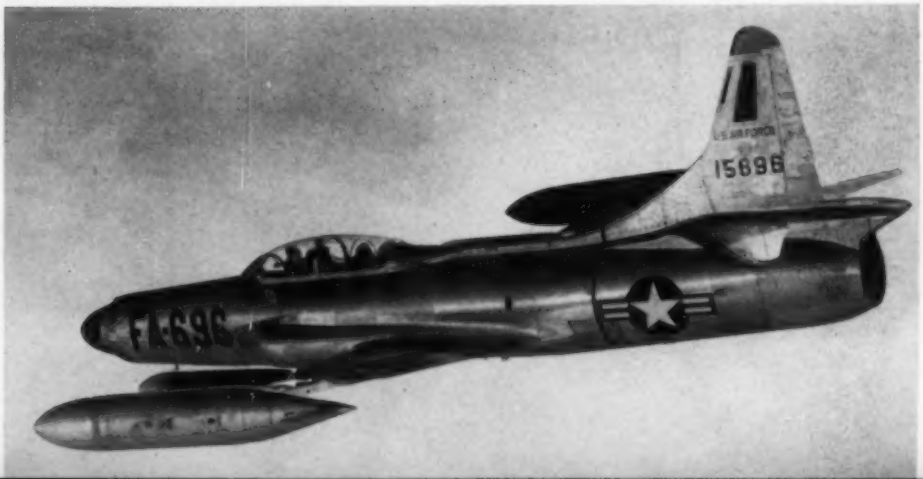
In view of its all-weather rôle the F-89D has an extensive thermal anti-icing system for the windscreen, wing, tail unit, rocket pods, and air intakes. All flying controls are hydraulically powered and irreversible, and air braking is achieved by the use of the ailerons as "decelerons."



Marcel Dassault Mystère IVN.

(Above) S.N.C.A.S.O. 4050N Vautour.

(Right) Lockheed F-94C Starfire.



The extensive internal fuel capacity is supplemented by two 300 U.S. gallon under-wing tanks with cartridge ejection, and maximum range is well over 2,000 miles. Gross weight is greater than 40,000 lb and top speed over 600 m.p.h.

Span, 59ft 8in; length, 53ft 4in.

Northrop F-89H Scorpion A new Scorpion variant, armed with six Hughes Falcon air-to-air guided missiles grouped three at each wing tip. The first flight was in September 1955 and production is far advanced.

FRANCE

Marcel Dassault Mystère IVN Though no production of this two-seat Mystère development is in view, it may be mentioned that it has two 30 mm guns and provision for 128 rocket projectiles in pods. Supersonic speed is attainable in the dive and level speed near the ground, with the Rolls-Royce Avon RA.7R turbojet using reheat, is over 700 m.p.h. Gross weight is more than 23,000 lb.

Marcel Dassault Mystère IVN2 A reported development of the above, with an Avon of five-figure thrust without afterburning, and having increased wing sweep.

S.N.C.A.S.O. 4050N Vautour The "N" version of the Vautour is an all-weather fighter with a crew of two, seated in tandem. The prototype flew in October 1952 and production is under way. S.N.E.C.M.A. Atar 101Es are fitted; empty weight is 23,150 lb, and gross weight over 35,000 lb. Maximum speed is of the order of 680 m.p.h., ceiling 49,000ft, and climb to 39,000ft is said to take less than six minutes. Armament of production aircraft will probably be four 30 mm DEFA guns, but provision may be made for a retractable rocket pack and under-wing rocket pods.

Span, 50ft; length, 51ft (approx.).

U.S.S.R.

"Flashlight" The foregoing is the Allied code designation of a standard type of Russian two-seat all-weather fighter first seen at the Tushino fly-past in July last year. It has a massive radar nose; tandem seating for its crew of two; a large fuselage suggestive of ample fuel capacity; and highly swept vertical and horizontal surfaces. Two turbojets, each, it is supposed, of some 9,000 lb thrust, are installed in underslung nacelles, and fairings at the wing-tips suggest that outrigger wheels may be used in conjunction with a centrally positioned main undercarriage.

SWEDEN

Saab J32 Lansen The J32 variant of the Lansen will be an all-weather two-seat version of the basic attack machine. Powered with a late-mark Rolls-Royce Avon with reheat, it is destined to replace de Havilland Venom night fighter squadrons of the Royal Swedish Air Force. Armament will certainly include air-to-air guided missiles, with automatic fire control.

MULTI-SEAT, CARRIER-BASED

GREAT BRITAIN

de Havilland D.H.110 Development and quantity production of this twin-Avon, twin-boom, carrier-borne, all-weather fighter—the first British fighter to exceed the speed of sound (in a dive) and the first in recent years to have an "all flying" tail—are both well advanced. Many months must elapse, however, before the type is in squadron service with the Fleet Air Arm.

It is not, perhaps, generally recognized that the design was prepared with naval requirements very much in mind. It was considered, for instance, that the traditional de Havilland twin-boom layout offered two particular advantages in that carrier stowage was facilitated (it being possible to push the nose of one machine beneath the high-set tail of the machine in front) and the installation of an arrester hook was relatively easy.

Development of the type was traced in *Flight* of January 21, 1955,

de Havilland D.H.110.

MILITARY AIRCRAFT, 1956

Fighters

MULTI-SEAT, CARRIER-BASED

from which these extracts are taken: "The interior is pressurized and air-conditioned, and is relatively roomy and pleasant. The pilot sits well up on the port side and has a superb view, particularly to port; the observer sits slightly behind and lower down and, although he has side and roof windows, can probably learn more about what is going on by studying the numerous tools of his trade. . . .

"There seems to be some justification for claiming that the 110 is more manœuvrable at transonic and supersonic speeds than any other aircraft. . . . Mach numbers well in excess of unity have been recorded on almost every recent flight, and rate of roll and turn are extremely high throughout the top end of the speed range. The entire flying-control system is hydraulically powered—even the rudders—and, in the air, the new all-flying tailplane behaves as a very powerful one-piece slab. It has not been found necessary to vary the tailplane gear-ratio for either end of the Mach scale.

"At the bottom end of the scale, the slow-speed control is first class in every respect, the drooping outer leading edge—which incurred no measurable drag penalty—being of assistance. The stall is all that a stall should be, straight and 'square' and with plenty of natural warning. Lowering the massive Fowler flaps unlocks what looks like an elevator from the slab tailplane, so that the trim change can be automatically cancelled out. The tail, nevertheless, retains great power for rounding-out, and the final touch-down is slower than that for the Sea Venom. Anti-skid braking will be a standard fitting."

Armament is four 30 mm Aden guns and under-wing air-to-air guided missiles. The guns are mounted beneath the cockpit floor on a demountable pack and ready access is provided for the ammunition loader and gun-hoist winch.

The operational version of the D.H.110 now in production is known as the Mk 20 (no name has yet been chosen) and will probably incorporate a more advanced mark of the Rolls-Royce Avon than that at present installed.

Among comparatively recent developments is the repositioning of the dive brake, which is now in the form of a single large surface under the forward fuselage. The large internal fuel capacity can be augmented by two external plastic tanks. Advanced A.I. radar and gun-laying equipment are, of course, provided.

Span, 51ft; length, 52ft.

de Havilland Sea Venom FAW.21 The FAW.21 version of the Sea Venom will remain as the standard all-weather fighter of the Royal Navy until the introduction—many months hence—of the D.H.110. It is a naval counterpart of the R.A.F.'s N.F.3 and has power-folding wings, catapult gear, provision for rocket-assisted take-off, and, of course, an arrester hook. Armament is four 20 mm guns. The Royal Australian Navy uses a similar machine, designated FAW.53, and a developed version (Aquilon) is built under licence in France (*q.v.*).

Span, 41ft 9in; length, 35ft 3in.

U.S.A.

Grumman F9F-8T Cougar More than a hundred of these two-seat Cougars are to be built for the U.S. Navy and the type will be used "as an operational fighter in addition to jet trainer missions." First deliveries will be made this summer, and it is expected that about one-half of the machines will be assigned to fleet squadrons and the other half to the U.S. Navy's Training Command. Armament is two 20 mm guns and there is provision for under-wing stores and for flight refuelling.

FRANCE

S.N.C.A.S.E. Aquilon (Two-seater) The first and second order for Aquilons covered the two-seat variant, generally similar to the de Havilland Sea Venom. The powerplant is a Fiat-built de Havilland Ghost 48 Mk 1, and S.N.C.A.S.O. ejector seats are fitted under a sliding canopy. Armament is four 20 mm guns, maximum speed over 560 m.p.h., and service ceiling about 49,000ft.

de Havilland Sea Venom FAW.21.

Turkish Air Force

WINGS OF NATO

Keeping the ceaseless vigil for peace, the North Atlantic Treaty Organization spreads its wings eastward from the seaboard of the Atlantic as far as the ancient gateway to Asia . . . where Turkey, astride the Straits of Bosphorus, guards the eastern flank.

Except for NATO, freedom as we know it could not survive. Not only a powerful deterrent to aggression, NATO, by its very existence, permits Western diplomacy to operate effectively from a position of strength.

Streaking across the picturesque skyline of Turkish cities today, one can see the familiar sight of Canadair-built Sabre jets—one of the finest aircraft in European squadron service—flown by the skilled pilots of the Turkish Air Force . . . a strategic unit of the "Wings of NATO" among the air forces of the free nations.

CANADAIR
LIMITED, MONTREAL, CANADA
AIRCRAFT MANUFACTURERS

European Representative: J. H. Davis, Princes House, 190 Piccadilly, London W.1., England

CANADAIR HAS PRODUCED MORE JET AIRCRAFT THAN ANY OTHER CANADIAN MANUFACTURER

SOLDERLESS TERMINALS & CONNECTORS

PRECISION CRIMPING GIVES

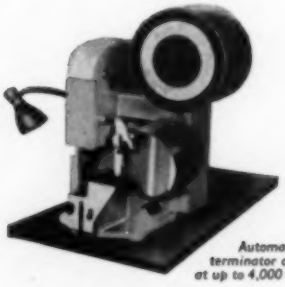
▶ *Faster working* ▶ *Greater economy* ▶ *Freedom from human error*

The AMP method of wire connection achieves a standard of electrical performance, mechanical efficiency and speed of output unobtainable by other methods. AMP terminations or connections are made to a uniform standard of excellence. They will not fail under vibration, strain or corrosive conditions; they give good performance at high altitudes and are particularly suited to electronics and general aircraft wiring.

AMP terminals are made for every type and size of wire

Brochure sent or demonstration at your own works on request

Pneumatic hand tool eliminates operator fatigue



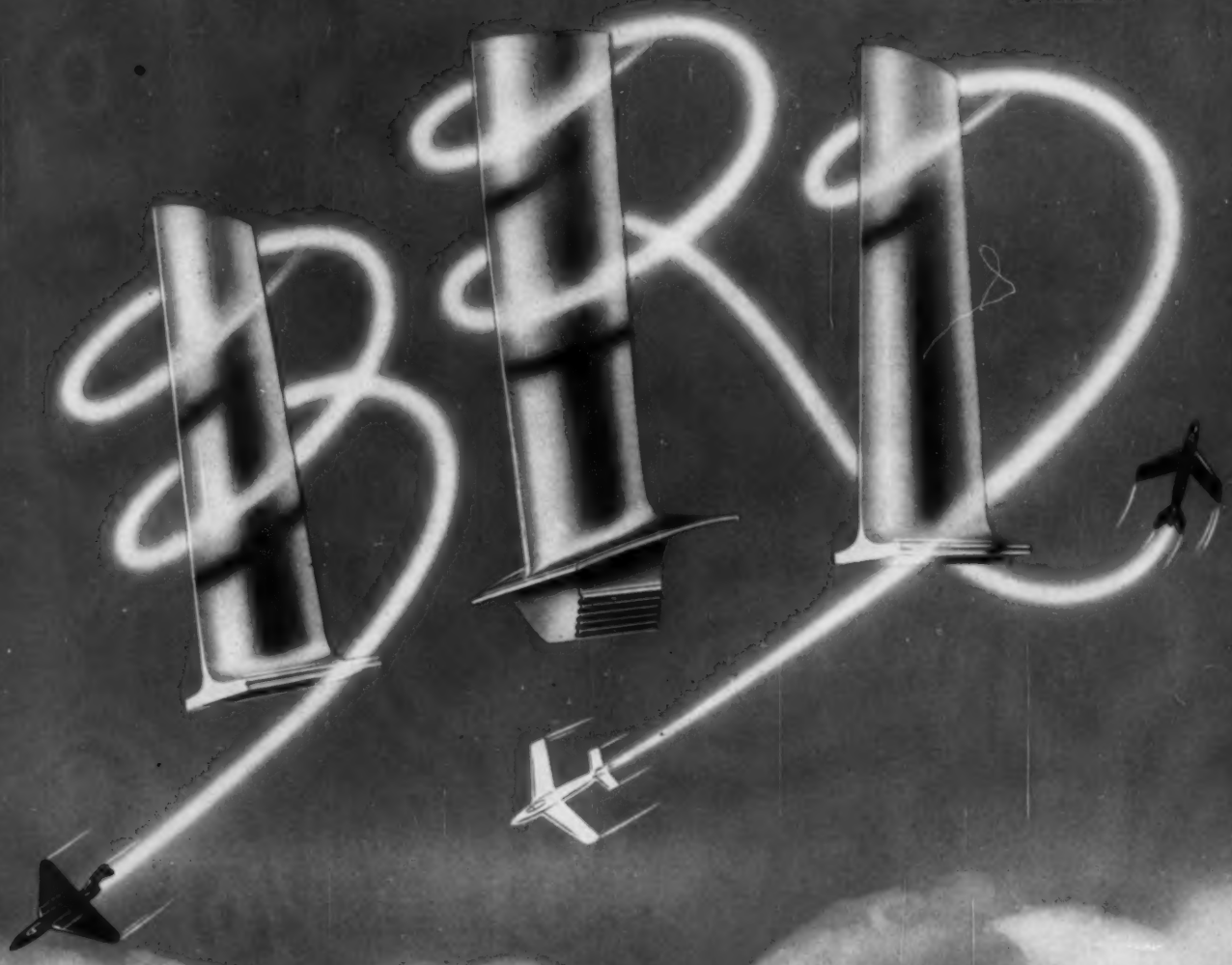
Automatic wire terminator operates at up to 4,000 an hour

AIRCRAFT-MARINE PRODUCTS (GT. BRITAIN) LTD.

London Sales Office: 60 KINGLY ST., W.1. Tel: REG 2517/8. Works: SCOTTISH INDUSTRIAL ESTATES, PORT GLASGOW, SCOTLAND

Ahead of the present — *— abreast of the future*

AP323-14



PRECISION MACHINED BLADES

B·R·D

COMPANY LIMITED

ALDRIDGE · STAFFORDSHIRE

Extensive resources available for prototype and large-scale production

aircraft pumps by Plessey

This is the main fuel pump for a small gas turbine. It is a positive displacement type, with a built-in filter and having a Duplex seal on the input shaft, with independently vented gland chamber to prevent any possibility of dilution of the engine oil with fuel. Pressure-loaded bearings ensure high volumetric efficiency under all operating conditions, not only when the pump is new, but also after prolonged service, because of the automatic adjustment for any slight wear that may take place. Special means of lubricating and cooling the bearings ensure that the pump is not liable to damage by dirty fuel. The particular unit illustrated provides a shaft drive for the fuel system governor which mounts directly on the pump end—and provides an outstanding example of the way in which Plessey will produce special pumps to meet any reasonable requirement.

BALANCED PRESSURE-LOADED BEARINGS

THE PLESSEY COMPANY LIMITED · ILFORD · ESSEX

A 63

GROUND ATTACK AND FIGHTER/BOMBERS

THE addition of "Fighter/Bombers" to the title of this section was in recognition of the already great significance of the supersonic fighter-type aircraft (such as the North American Super Sabre) carrying a nuclear weapon. And though that weapon may be formally described as "tactical", it must be recognized that such machines, even when carrying such devastating armament, may have (especially with flight-refuelling) "strategic" range. Moreover, unlike the representative types of ground-attack fighter-adaptations which comprise the bulk of types reviewed, they are able to deliver their war load with accuracy from great altitudes, using new radar aids.

Specialized attack machines designed for indigenous requirements are represented by the Swedish Lansen and the Swiss P-16; and we have included due references to the Canberra, B-57 and Vautour (basically light bombers) as equipped for the ground-attack rôle. The NATO-sponsored or -inspired light single-seaters (of which the Fiat G.91 is the most promising example) are, it would appear, open to criticism by reason of their light war-loads and questionable accuracy of delivery.

Particular interest attaches to the experimental employment of air-to-ground missiles from a helicopter (S.O. Djinn)—a form of attack, this, which may finally end the once-promising career of the Potez 75 "tank-stalker". It is not without interest, incidentally, that the "75" has been adapted for colonial use, "second class" warfare being much in the thoughts of the French —and other—Governments. A project for a twin-engined "colonial police and night interdictor"—the S.O.7100 Dogue, with Leonides engines, 30 mm guns, bombs and rockets—never came to fruition.

Meanwhile, ex-fighter Ouragans are being developed, with special undercarriages, for rough work overseas, and research is proceeding in France, as in other countries, with various aids to take-off and landing, in recognition that "close support" may often entail close basing as well as close fighting.

GREAT BRITAIN

English Electric Canberra B(I).8 For ground attack and night intrusion this version of the Canberra carries four 20 mm guns, combined, with ammunition supply, in a quickly replaceable pack developed by Boulton Paul. A very large quantity of ammunition is provided for each gun, possibly of the order of 500 rounds. Provision is made for internal and external bombs. Pending introduction of B(I).8s into squadrons converted B.6s, known as B(I).6s, have been placed in service. These otherwise standard bombers carry a gun pack and wing bomb pylons.

Folland Gnat As a tactical support aircraft the Gnat can carry as alternative loads, additional to two 60-gal drop tanks, two 500 lb bombs, twelve 3in rocket projectiles, or two napalm bombs. Without drop tanks, eighteen 3in r.p.s. or two 500 lb bombs and six 3in r.p.s. are possible loads. The small size of this aircraft confers a valuable element of tactical surprise.

Hawker Hunter Hunter Mks 4, 5 and 6 have provision for under-wing ordnance. Possible loads are 24 rocket projectiles mounted outboard of under-wing tanks, or two 1,000 lb streamlined bombs.

U.S.A.

Douglas F4D-1 Skyray Possible attack loads of this carrier-borne fighter (additional to four 20 mm guns) are two 1,000 lb or 2,000 lb bombs, or six pods each containing seven 2.75in folding-fin rockets, or four pods each with 19 projectiles of the same calibre.

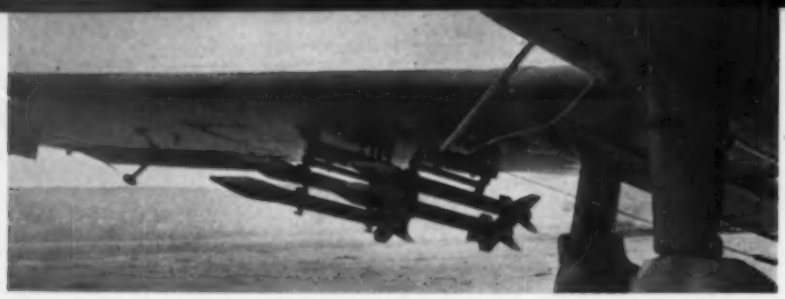
Martin B-57B In the low-attack rôle the B-57B bomber is well qualified, for it mounts eight 0.5in or four 20 mm guns and carries such external loads as eight 5in rockets and four napalm tanks, in addition to internally stowed bombs.

North American F-86F Sabre Conventional attack loads of this machine can be two 1,000 lb bombs or sixteen 5in rocket projectiles. Gun armament is 6 × 0.5in. Under the designation F-86F-35 the type has been developed to carry "special weapons," and it is reported that the only modifications necessary are the installation of an S-3 bomb rack and the "instrument required for delivery." No airframe modifications are apparently called for.

North American F-86H Sabre In addition to the built-in armament of four 20 mm M-39 guns, the F-86H has provision for under-wing loads as specified for the F-86F.

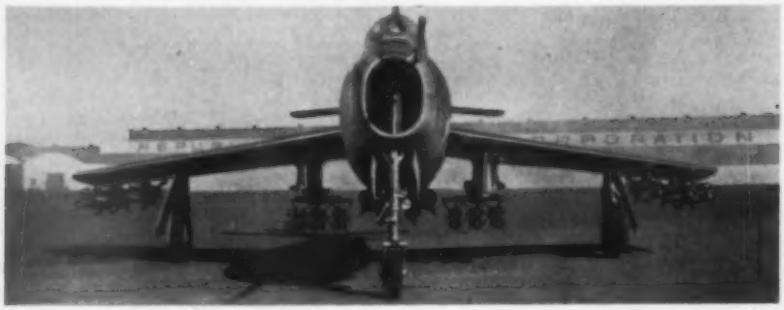
North American F-100D Super Sabre Testimony to the potency of the Super Sabre in the ground-attack rôle is the photograph on this page, showing an F-100C with a bomb load of 7,000 lb. The "D" variant

North American F-100C Super Sabre.



Anti-tank rockets on a Potez 75. Part of a missile pylon is visible on the extreme left.

ATTACK



A Republic F-84F Thunderstreak loaded with twenty-four 5in high-velocity air-to-ground rockets.

Air-to-ground R.P.s and auxiliary tank on Hawker Hunter F.4.

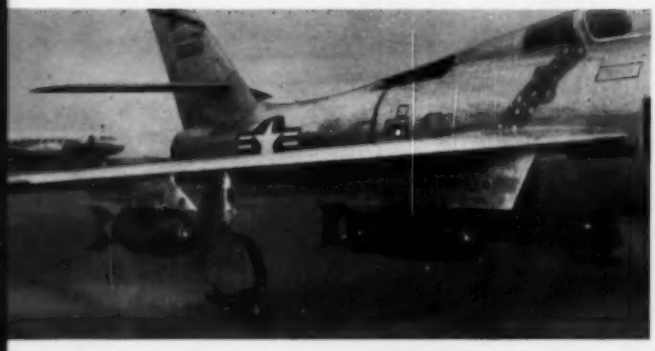
A 1,000 lb bomb and auxiliary plastic tank on Hawker Hunter F.4.

S.O.4050 Vautour with under-wing containers for rocket projectiles.

Bombs and auxiliary tanks on the underwing pylons of a North American F-100.

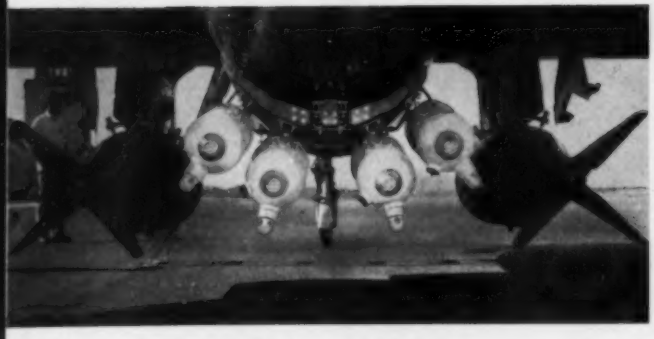
LOADS

Eight of the sixteen 5in high-velocity air-to-ground rocket projectiles carried under the wings of a Martin B-57B.



(Left) 2,000 lb and 1,000 lb bombs on a Republic Thunderstreak.

Fourteen rocket projectiles and gun ports on a Saab A29.



(Left) Two 2,000 lb bombs and four jet-assisted-take-off bottles installed on a Republic F-84F Thunderstreak.

5in rockets, 11.75in "Tiny Tim" rocket and wing-mounted 20 mm guns on a Douglas AD-5 Skyraider.

MILITARY AIRCRAFT 1956

Ground Attack and Fighter/Bombers

is equipped with a Minneapolis-Honeywell automatic pilot developed expresaly for supersonic flying, and this, it is claimed, enables the pilot to concentrate on navigation or other phases of his mission and relieves him of fatigue. Also installed is "an improved method of accurately delivering bombs to a target"; probe-and-drogue refuelling system and a North American Autonetics Division yaw damper system. Gun armament is four M-39s of 20 mm calibre.

In *Flight's* detailed description of the F-100 (May 20th, 1955) there was a diagram, based on official information, showing typical underwing loads for the "A" variant, and these may be supposed to apply to the "D" also. They included 750 lb, 1,000 lb and 2,000 lb general-purpose bombs; 750 lb napalm tanks; M-26 or M-28 chemical tanks; streamline stores described as 500 lb "Ex 12", 1,000 lb "Ex 10" and 2,000 lb "Ex II"; packs of forty-five 2.75in folding-fin rockets; and 200 and 275 U.S. gallon fuel tanks.

For maximum range the F-100 carries two "low-speed" fuel tanks and two "unlimited" tanks. The low-speed tanks are drained during take-off and climb to operating height and are then dropped before the aircraft works up to high Mach numbers. The unlimited tanks can be retained during supersonic flight.

The "special" (nuclear) weapon has a high drag trajectory to permit the launching aircraft to get well clear before detonation. It is thought, however, to be streamlined until released.

Republic F-84F Thunderstreak The Thunderstreak can carry any of 22 different combinations of armament and auxiliary tanks, made up from rocket projectiles, bombs of 2,000 lb, 1,000 lb or 500 lb nominal weight, and 230 U.S. gallon or 450 U.S. gallon fuel tanks. Principal combinations are 24 rockets or four bombs or four tanks (two large, two small), or three tanks and a nuclear weapon. Maximum rocket load is 32 × 52in and built-in armament is six 0.5in guns.

To assist take-off at heavy load four RATO bottles, providing 4,000 lb thrust for 13 seconds, can be attached by means of a jettisonable collar. Experiments have also been made on a machine of this type with Goodrich inflatable rubber wing surfaces. Air is pumped in under the leading edge with the object of modifying the section to reduce take-off and landing speeds and distances.

Republic XF-84H Although no orders have been announced for a fully operational version of this turboprop aircraft, the makers' claim that it "meets requirements for a U.S.A.F. low-level fighter/bomber or Navy carrier-based dive bomber" is certainly no idle one. The primary function of the machine at present is the testing of supersonic airscrews, and it has been shown to combine high speed and rate of climb with quick take-off. The turboprop is an Allison XT-40-A-1, developing 5,850 equivalent shaft horse-power for take-off and designed to take an afterburner. When this is installed the "H" will become the first aircraft to have the turboprop/reheat combination. Engine air is taken in through the wing-root ducts. Other design features are a slab tail-plane mounted at the extreme tip of the high fin and a Republic-designed "vortex gate"—a triangular fin mounted just aft of the cockpit canopy partially to neutralize the tremendous torque of the airscrew. An automatic airscrew governor maintains constant r.p.m. and speed changes are controlled by automatic pitch change. Reverse pitch is available to brake the landing run. The makers claim a range of more than 2,000 miles (which should be easily attainable) and a service ceiling of over 40,000ft.

Span, 33ft 6in; length, 51ft 6in.

Republic F-105B See under fighters. Very heavy attack loads are possible.

FRANCE

Breguet 1001 and 1100 Taon Designed to the NATO light fighter/attack specification, these machines will carry the prescribed armament of two 30 mm guns with 120 rounds apiece, two 500 lb bombs, or two 770 lb napalm tanks, or twelve 3in rocket projectiles.

Marcel Dassault Barougan The name Barougan has apparently been applied to a special ground-attack version of the straight-wing Ouragan (predecessor of the Mystère) as fitted with a special double-wheel undercarriage for ground attack operations from poorly surfaced airfields in North Africa.

Marcel Dassault Mystères Like most other fighters of their class, the Mystères can carry bombs, R.P.s or napalm tanks.

Marcel Dassault Mystère 22 This light fighter/bomber is powered by two Turboméca Gabizos and is designed to a French Air Force specification. Air brakes are mounted far forward under the fuselage.

Marcel Dassault Mystère 26 Generally similar to the Mystère 22, this machine conforms to the NATO light ground-attack specification and is to be powered with a Bristol Orpheus turbojet.

S.N.C.A.S.O. 4050A Vautour The "A" suffix denotes the attack version of the Vautour, the first prototype of which flew in December 1953. The aircraft is laid out as a single-seater and is armed with four 30 mm guns and various combinations of rocket or bomb loads, including six 1,000 lb bombs which are extended from the bomb bay before release. A picture on page 722 shows a Vautour with rocket pods.

S.N.C.A.S.E. 5000 Baroudeur Though quantity production does not now appear likely, a "pre-series" of three Baroudeur trolley-launched skid-landing ground attack aircraft has been built for the French Government in addition to two prototypes. Two examples have the Atar 101D-3 turbojet; the third has an Atar 101E.

The launching and landing sequence developed for the Baroudeur is now well known. Briefly, the machine is mounted on a trolley (rocket-assisted when necessary) which runs true, with or without load, over rough ground. Mounting on a trolley takes about a minute and a half, by means of a jeep which uses its power to winch the machine over spiral rollers. When "unstick" speed is attained a cockpit light warns the pilot when to release the trolley. He thereupon eases back on the control column and the aircraft flies off. The trolley is automatically arrested in less than a hundred yards. Full-load take-offs of less than a thousand yards are possible. Landing is effected on two main skids and a rear skid—all retractable—and each skid has a braking hook. The trolley is light enough to be carried in flight if need be. Operation is

Rocket-assisted take-off by a Republic F-84F Thunderstreak.

S.O.4050A Vautour.

possible from very hard, very soft or pebbly ground, uneven grass strips, snow or sand.

Built-in armament is two 30 mm guns, and various combinations of bombs, rockets or napalm tanks can be carried under the wings. Empty and gross weights are respectively 10,400 lb and 13,500 lb. Supersonic speed is attainable in the dive.

Span, 32ft 9½in; length, 44ft 3in.

S.N.C.A.S.O. Djinn As seen in a photograph on page 726, this little turbine-powered helicopter has been used for experiments with S.S. 10 wire-controlled guided missiles.

Potez 75 It may be recalled that this comparatively low-performance, twin-boom, piston-engined machine was designed as a specialized "defence vehicle" or "an army missile-launcher that flies." It was intended to stalk its prey away from roads, using natural cover, and its primary mission was the attack of armoured spearheads while they were still on relatively unconsolidated territory.

Weighing 5,280 lb all-up, it is powered with a Potez 8-D32 engine of 480 h.p. and can operate (as frequently demonstrated) from unprepared ground—even from tilled land or stretches of road. Primary armament is two S.S.10 wire-controlled air-to-ground missiles aimed by the observer/weapon controller in an armoured cockpit in the extreme nose. The pilot's cockpit—also armoured—is immediately behind.

Early last year the Potez 75 was adapted as a ground-attack aircraft for colonial use, entailing the fitting of four 7.5 mm guns in the nose in addition to eight under-wing rockets and the S.S.10 missiles. At the time it was stated that a special patented device offered additional safety "comparable to the war-time flak suits."

With missiles in place the aircraft can achieve 170 m.p.h. all out.

Potez 75 carrying S.S.10 air-to-ground missiles.

Republic XF-84H.

S.E.5000 Baroudeur operating under wintry conditions.

MILITARY AIRCRAFT 1956

Ground Attack and Fighter/Bombers

ITALY

Fiat G.91 Resembling a miniature F-86D, this light attack machine was successful in the NATO competition. Three prototypes and 27 pre-production machines are on order. The Bristol Orpheus turbojet takes air through a beard-type intake, on either side of which lie the guns. The primary war-load of bombs, rockets or napalm tanks is, of course, stowed under the wing. The photograph of a model reproduced on this page shows (by comparison with earlier views) a redesigned nose and air intake. No gun ports are visible but previous drawings and models have shown either four of these (presumably for 20 mm guns) or two (for 30 mm weapons). The air brake is located under the fuselage.

Gross weight is thought to be about 12,000 lb.

Fiat G.91.

SWEDEN

Saab A32 Lansen The design of the Lansen two-seat all-weather attack aircraft—to the specifications of the Royal Swedish Air Board—were put in hand during 1951/52 and the prototype flew in November of the latter year. Design features include Saab ejection seats for pilot and navigator, thermal de-icing for the wings, tail and air intakes, an automatic pilot, Fowler-type flaps to confer good short-field performance, a Saab-designed cold-air unit and cabin-conditioning system, and provision for a large ventral auxiliary fuel tank. Early production machines are powered by the Svenska Flygmotor R.M.5, which is the Rolls-Royce Avon of the RA.7R type built under licence in Sweden. An afterburner brings sea-level emergency thrust to nearly 10,000 lb. Later types of Avon are in prospect for future versions.

Supersonic speed has been achieved in the dive on many occasions, frequently with external stores in place. Built-in armament is four 20 mm guns, weight empty about 15,500 lb, gross weight about 22,000 lb, maximum speed about 700 m.p.h., landing speed 125 m.p.h., and service ceiling about 50,000ft.

Span, 42ft 8in; length, 48ft.

Saab A29 This is the specialized attack version of the J29 fighter with provision for under-wing ordnance loads, typical of which are sixteen 145 mm Bofors R.P.s.

Saab A32 Lansen.

F.F.A. P-16.

SWITZERLAND

F.F.A. P-16 The first prototype (P-16 Mk 1) of this unusually interesting attack machine—a product of Flug- und Fahrzeugwerke A.G.—was destroyed last autumn. A second, designated P-16 Mk 2, has not yet flown. The type has been specifically designed for operations over Switzerland and is powered by an Armstrong Siddeley Sapphire ASSa.6, of 7,900 lb thrust, taking its air through flank intakes.

First requirements were good climb and acceleration, coupled with the ability to lift heavy armament loads from the many small airfields tucked away in the narrow valleys of the Alps. This meant that exceptional slow-speed characteristics were needed, leading to some form of compromise between very high performance and tractability at low speeds. For this reason a thin, low aspect ratio (4.5) wing form with moderate leading-edge sweepback (about 15 deg) was combined with drooping ailerons and high-lift devices. Part of the considerably increased lift available for slow flying is provided by special flaps which extend over the whole span between the ailerons and under the fuselage. The tip-tanks act as end plates as well as having a structural function and are therefore not jettisonable.

The P-16 is remarkable in its class for having a weapons bay in the fuselage centre-section, designed to accommodate rockets, fragmentation or napalm bombs or, for ferry purposes, a large fuel tank. Two Oerlikon 302 RK 30 mm guns with a rate of fire of up to 1,200 r.p.m. and a muzzle-velocity of over 3,600ft/sec, are permanently mounted in the nose, and additional armament may be carried under the wings. There are five fuel tanks, including those at the wing-tips, all of which can be rapidly replenished through a single nozzle.

S.O.1221 Djinn launching an S.S.10 air-to-ground missile.

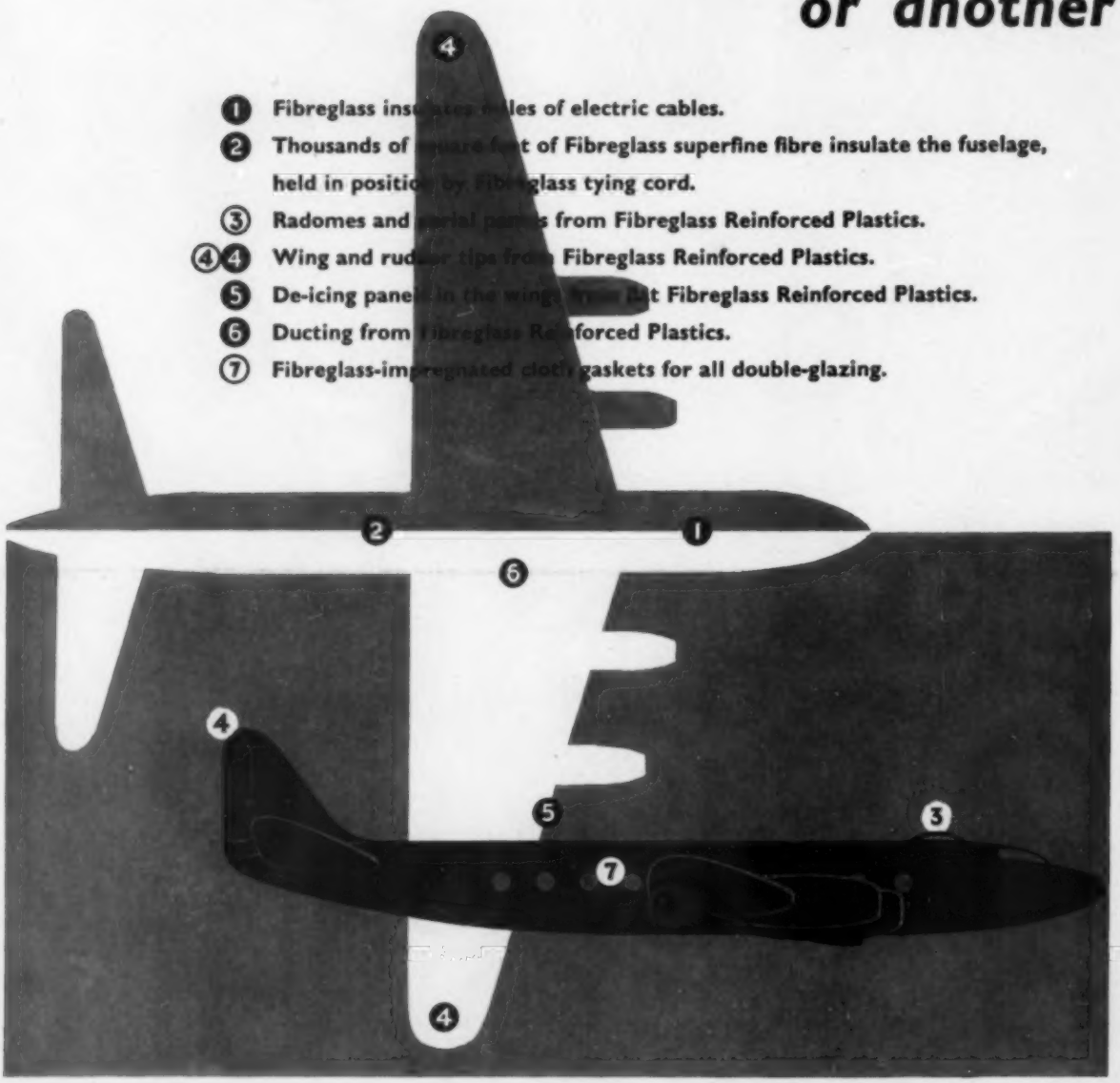
are you interested in power?

This is half of the low pressure compressor casing of the new Bristol BE 25 supercharged turboprop engine. Designed to maintain a constant power of 4000 hp from sea level to heights around 20,000 feet, the BE 25 is being developed to power the airliners of the 1960s. This is but one of a number of engine projects which Bristol has under development today to power the commercial and military aircraft of tomorrow. For this vitally important programme, draughtsmen and technicians are urgently needed in the design offices of Bristol Aero-Engines Limited, both in Bristol and in London. Apply for fuller details to the Personnel Manager.

BRISTOL

BRISTOL AERO-ENGINES LIMITED . FILTON HOUSE . BRISTOL

Most British Aircraft use FIBREGLASS (TRADE MARK) in one form or another


4
1 Fibreglass ins les of electric cables.
2 Thousands of t of Fibreglass superfine fibre insulate the fuselage,
held in positio glass tying cord.
3 Radomes and s from Fibreglass Reinforced Plastics.
4 4 Wing and rud r tips fro Fibreglass Reinforced Plastics.
5 De-icing pane t Fibreglass Reinforced Plastics.
6 Ducting from forced Plastics.
7 Fibreglass-im gaskets for all double-glazing.
2
1
6
4
5
3
7
4

For lightness . . .
For strength . . .
For insulation . . .

FIBREGLASS (TRADE MARK)

FIBREGLASS LIMITED, RAVENHEAD, ST. HELENS, LANCS. (St. Helens 4224)
LONDON OFFICE: 63/65 PICCADILLY, LONDON, W.1. (Hyde Park 2115)

BOMBERS

THE development of strategic bombers in recent years has taken the familiar leap-frog path. Following Germany's lead, America was soon in the field with a large multi-turbojet machine —the Boeing B-47 of 1947/8—and for maximum range she had recourse (in the Convair B-36, now ten years old) to the mixing of turbojets with piston engines. Both types were built in great quantities and the B-47 remained supreme in its class, numerically and in point of quality, until surpassed in all-round performance by the British V-bombers and by its own stablemate the B-52. In its massive deterrent strength, however, the force of some 1,500 B-47s now available to the U.S.A.F.'s Strategic Air Command will dominate the scene long after the mammoth B-52—eight-jet successor to the ten-engined B-36—is worked up to full operational standard in the coming months.

Though smaller in size and ordered in fewer numbers than the B-52, the Handley Page Victor and Avro Vulcan should prove superior to the great American bomber in important aspects of performance, though the "52" itself is officially declared to have a top speed of 650 m.p.h. and an operating altitude of over 50,000ft. With her four-jet "Bison," Russia is well to the fore both in quality and numbers; over 100 were thought to be in service last May. Russia alone, with the swept-wing "Bear," has turned to the turboprop to reconcile high performance with extreme range.

Counterpart in the Soviet squadrons of the six-jet B-47 and four-jet Valiant is the twin-jet Badger—a design of distinct merit; and in the "light"/"tactical"/"intruder" class the British and American versions of the English Electric Canberra are supreme, and will continue so at least until the Douglas B-66 can establish itself with the U.S.A.F. Future tactical possibilities are suggested by a projected Martin supersonic bomber designed for zero-length launching. The Convair Hustler has itself been considered for tactical employment—but for that matter it has been proposed as an intercepter fighter also!

Though we have seen that supersonic atom-bombers are now with the American squadrons (in the form of radar-aided bomb-carrying fighters such as the North American F-100C), the ability to cruise above Mach 1 over great ranges remains a distant goal. With the Convair B-58 Hustler, soon to fly, America holds an expected lead, though this pioneer "podded delta" may well prove as vexatious in development as did its near-relation, the F-102.

For very high supersonic speed over long ranges we must look to the bomber, or bombers, now being designed for the Royal Air Force and to corresponding American machines, two of which (Lockheed and Convair) have atomic power, and one—the Boeing Model 110—uses chemical (ethyl-borane) fuel.

Meanwhile the ability of the manned bomber to deliver its load with sureness and accuracy will soon be enhanced by new weapons and techniques. The guided bomb, typified by the radio-controlled Bell GAM-63 Rascal, is almost here, and other weapons, possibly with ranges of up to 1,000 miles, are in prospect. (Of the Rascal, which has a range of about 100 miles, the U.S. Assistant Air Force Secretary for Materiel said last April that more examples had flown since the previous July than in the previous two years of testing.) These guided bombs will render the delivering aircraft less vulnerable, not only by allowing it to remain far from the target defences but in obviating exposure to the heat and blast damage of nuclear weapons. In this latter connection it may be remarked that a B-36 flying at 20 miles slant range from the 15 megaton hydrogen test device exploded on the ground at Eniwetok suffered heavy and extensive heat and blast damage.

The possibility of releasing conventional bombs at supersonic speeds has been proved by the U.S. Navy up to a Mach number of 1.2, a device having been developed to enable the bomb to take up a normal trajectory, thus overcoming the tendency for it to remain with the aircraft at supersonic speed.

Modern bombing aids are exemplified by the BRANE system (see under Boeing B-52); and being designed for the U.S.A.F. by the Massachusetts Institute of Technology is an inertial system which can operate without visual or radar reference to the ground.

For the protection of bombers the Americans and Russians retain their gun armament, generally with automatic laying and triggering, whereas the British V-bombers depend upon their exceptional altitude and speed capabilities and on their powers of evasion. Bomber-defence guided missiles are under development by General Electric's special projects division, and a form of forward defence may be provided by "chaff-carrying" rockets fired ahead of the bomber to confuse the enemy radar.

BOMBERS | MEDIUM AND HEAVY

GREAT BRITAIN

Possible Supersonic Bomber There has been no official intimation of the form the supersonic British bomber will take, but it might reasonably be supposed that it will follow the pattern of a model presented to Princess Margaret by Sir Arnold Hall (formerly Director of the Royal Aircraft Establishment, and now technical director of the Hawker

Avro Vulcan B.1.

Bomber Equipment

Crew of a B-52 with pressure suits and other accoutrements.

Using the periscope of the B-52's BRANE bombing/navigation system.

(Above) Seven 1,000 lb bombs for a Short Sperrin.

(Left) Fitting a 1,870 U.S. gallon tank on a B-47.

(Below) Possible loads of a Martin B-57B: included are a 5in rocket, 52 lb flare, 1,100 lb chemical tank, 750 lb demolition bomb, 500 lb G.P. bomb, 260 lb fragmentation bomb, 140 lb rocket pod, 1,000 lb G.P. bomb, 500 lb "frag" cluster, a second type of 500 lb G.P. bomb, and 220 lb bomb. Four (20 mm) or eight (0.5in) guns are additional.

Handley Page Victor B.1.

MILITARY AIRCRAFT 1956

Bombers

MEDIUM AND HEAVY

Siddeley Group) on the occasion of the R.A.E. 50-year celebrations last year. This model had a very slender fuselage and small, straight-tapered wings carrying jet installations at their tips. A large long-range bomber of the type under contemplation would, of course, require an enormous thrust and might have two, three or more turbojets, of 20,000 lb thrust or greater, in each wing-tip housing.

Possibly connected with such a project is the "1,500 m.p.h. airliner" of which a preliminary design study has been made by Avro.

A machine of somewhat similar characteristics, but having a "foreplane" instead of a tailplane, has been proposed by Handley Page, Ltd. In this design aspect ratio is extremely low and the power units are mounted in deep, narrow pods at the wing tips. Of such an installation it has been remarked by Handley Page's technical director: "As the requirements for air-intake geometry are very different in subsonic and supersonic flight, it will be necessary to arrange the intake such that the entry size and shape can be varied. This is much more simply arranged when the intake is a long narrow slit in cross-section than when the entry is circular. It is therefore more advantageous to employ a number of small engines in a row rather than a small number of large engines. A further consideration, too, is that a number of small engines is lighter than a single large engine giving the same total thrust." In the same dissertation he discussed other aspects of supersonic-bomber design in these terms:

"With a supersonic fighter aeroplane, it is practicable to arrange the heat balance such that the time required to attain the stabilized temperature exceeds the expected endurance. For the supersonic bomber, however, flight endurance at supersonic speed will be much greater than the temperature-stabilisation time; therefore we have to consider the full heating effects on structural material properties and on the crew and equipment. Elaborate insulation and cooling arrangements are required together with the best utilization of the available heat sinks. A special difficulty arises over cooling because the familiar heat exchangers cannot be used. Any heat exchanger surface exposed to the airstream will get as hot as the rest of the aeroplane. Thus we are forced to the use of refrigeration or evaporative cooling. Evaporative cooling is heavy because of the weight of the evaporative material but, owing to the high fuel flow-rate required by the power plants, fuel can provide a practical cooling medium for a refrigeration plant without weight penalty.

"For the bomber, it will be essential to insulate the fuel tanks so as to obviate fuel boiling.

"For the supersonic aeroplane, it is essential that frontal area is reduced to the bare minimum and that the fineness ratio is large in order that wave drag can be minimized. This requirement has an important effect on wing design, since the wing depth permissible will be about 3-4 per cent only. With wings so thin it is uneconomic to use them for stowage of fuel. So, for a long-range supersonic aeroplane, fuel stowage volume becomes a criterion for design of the fuselage.

"Another feature of supersonic flight that has an important effect on the shape of the aeroplane is associated with the change of trim that occurs at transonic speed. In going from subsonic to supersonic flow, a wing suffers a large rearward shift of the centre of aerodynamic pressure; to balance this, a tailplane will experience a large change of trim load in the downward direction. This adds to the load that the wings must sustain and the induced drag is increased to the detriment of performance and range. One proposal to overcome this difficulty is to carry a spare tank at the rear of the aeroplane and to pump fuel into it to re-balance the aircraft while it flies supersonic. A disadvantage of this method is that the fuel required for balance cannot be used for supersonic flight. Another method is to mount the horizontal stabilizer ahead of the wing. In this way any rearward shift of aerodynamic forces on the wings is reacted by an increase in the trim load in the upward sense. Thus, the horizontal trimming surface or foreplane contributes to wing lift and induced drag is saved.

"There is at present no evidence to show that a particular wing planform has a clear advantage for supersonic flight . . ."

Avro Vulcan B.1 Only scant information concerning the delta-wing Vulcan has become available since our former review, though development flying on the prototypes and pre-production machines has gone ahead at a high rate. It was noticed at the S.B.A.C. Display last year that the nose had been revised in contour and that it embodied a very large dielectric covering over what was considered to be "the most expensive and advanced radar bomb-sight ever carried by a British aircraft." The optical sighting station was retained under the nose. A modified form of intake admitted air to the four Bristol Olympus two-spool turbojets and it was remarked that these units delivered more thrust at maximum altitude than did the engines of any other V-bomber. Air brakes were retained above and below the wing.

The Vulcan's extremely high standard of manœuvrability was demonstrated on the same occasion by repeated upward rolls—slow, unbarrelled rolls at about 30 deg to the horizontal.

In the important matter of high-altitude handling, it has been suggested that the relatively thick delta wing has imposed restrictions, though it should not be assumed that this—if true—is necessarily connected with a statement by the Defence Minister that "for certain operational rôles" the rival Victor has features "which may make it more effective and suitable than the Vulcan." Nor is there any official confirmation of a report that instability has been experienced on high-speed level runs at height.

Since the Farnborough Display a very significant innovation has been disclosed. Taking the form of a revised outer leading edge this has the effect of reducing thickness/chord ratio and improving both high- and low-speed performance and handling. A makers' announcement claims that the modification will "make the fullest operational use of the more powerful engines which will shortly start to become available."

It may be added that when a former Minister of Supply flew in a Vulcan at over 50,000ft he stated that the prototypes had not then been "pushed," and that there was little doubt that the Vulcan still had "quite a lot up its sleeve."

The hope was expressed by the Secretary of State for Air in March that Vulcans would be in squadron service this year; and, he added, "the performance of later marks represents a considerable development potential."

Span, 99ft; length, 97ft 1in.

Vickers-Armstrongs Valiant B.1 Scores of Valiants have been delivered to the R.A.F. in recent months and hundreds of select crew-men have undergone intensive training in their operation. The essential characteristics of the machine (moderately loaded and gently swept wing with four "buried" Rolls-Royce Avon turbojets of an advanced series) are now familiar, and though very little technical detail has been disclosed, a visit last April to a Valiant operational conversion unit was productive of some new facts. These are extracts from our report:—

"Each crew consists of a captain, co-pilot, navigator plotter, navigator

Vickers-Armstrongs Valiant B.1.

MILITARY AIRCRAFT 1956

Bombers

MEDIUM AND HEAVY

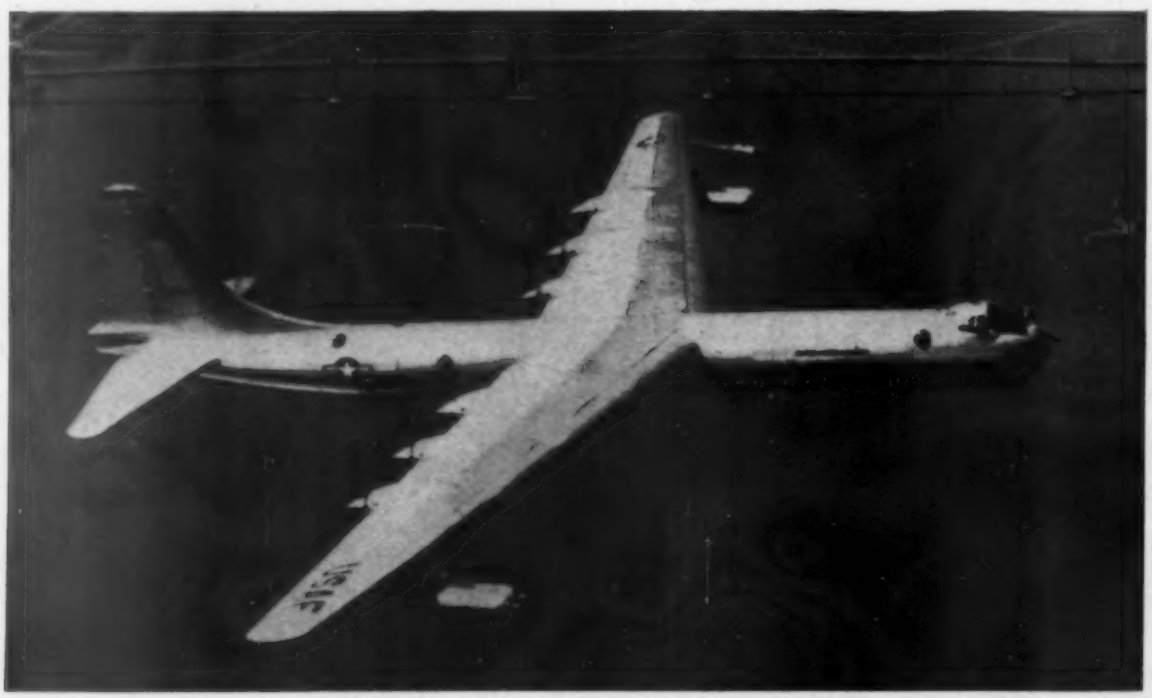
radar bomb-aimer and a signaller. All sit together in a pressurized cabin in the nose, the two pilots side by side in front and the others facing rearwards below and behind them. The crews report very favourably on the comfort and handling of the machine. . . .

"Since the R.A.F. has now adopted I.L.S. as a standard approach aid, the Valiant is fitted with a Smiths autopilot with an approach coupler which will allow automatic I.L.S. approaches in poor weather down to a height of 200ft. Talk-down approaches with the Decca airfield control radar Mk 7, now installed at many bomber airfields, can also be made with cloud ceilings down to 200ft, though limits for both types of approach will be lowered in the not-too-distant future. . . .

"The Valiant is big, having a length of 108ft 3in and a span of 114ft 4in. . . . Undercarriage, flaps, air-brakes, bomb doors, tailplane incidence, trim, fuel pumps and the flying control hydraulic pumps are all electrically operated. There are 38 miles of wiring, 85 electric motors and actuators and 225 electrical relays of 49 different types. Controls are fully powered, with manual reversion. Artificial feel is provided by a mechanism in the tail, using dynamic pressure sensed from an intake at the root of the fin. Pressurization charge air is tapped from all four engines, and two settings are available, one for normal flight and the other—rather lower—for operational situations. An emergency system will give greatly increased flow to maintain some pressurization despite a puncture of the cabin wall. Before the pilot finally reaches his seat 70 items outside and 40 inside the aircraft have to be checked. Sixty items on the panel are checked before the engines are started. The four Rolls-Royce Avons are started with the aid of a large generator trolley which can also supply power for servicing work. There is a connection in the fuselage side for supply of conditioned air from external sources on the ground. . . ."

It was made clear that the Valiant is complex, though pleasant to fly

Convair RB-36.



Boeing B-52C.

and not abnormally prone to unserviceability. But so much of the nation's resources are tied up in the equipment that the risk of losing a Valiant through any kind of crew inefficiency could not be accepted. Moreover, the task of delivering a nuclear weapon—and the Valiant was said to be capable of delivering any one of a number of types—could not be entrusted to any but the most skilled and reliable crews. Thus a new high standard of flying and bombing skill is being set and the cream of the R.A.F. is being taken to form the new V-force.

It was also disclosed on the occasion of the visit to the Valiant O.C.U. that a number of these machines are equipped for flight refuelling, and that shown in our photograph is, indeed, one of these. The stump of a flight-refuelling probe is visible in the nose and the "ridge" running alongside the canopy is presumed to be connected with the probe installation. Auxiliary tanks can be carried under the wing and—for ferrying—in the bomb bay. Indicative of the range potential of the Valiant B.1 were the planned stages for an England-New Zealand flight which, in the event, did not take place. They were: London-Karachi (4,192 miles), Karachi-Cocos Islands (3,255 miles), and Cocos Islands-Christchurch (4,929 miles). As for speed, a production Valiant has flown to Australia, setting up two records on the way. From London to Baghdad it averaged 523 m.p.h.; from Singapore to Darwin, 518 m.p.h.

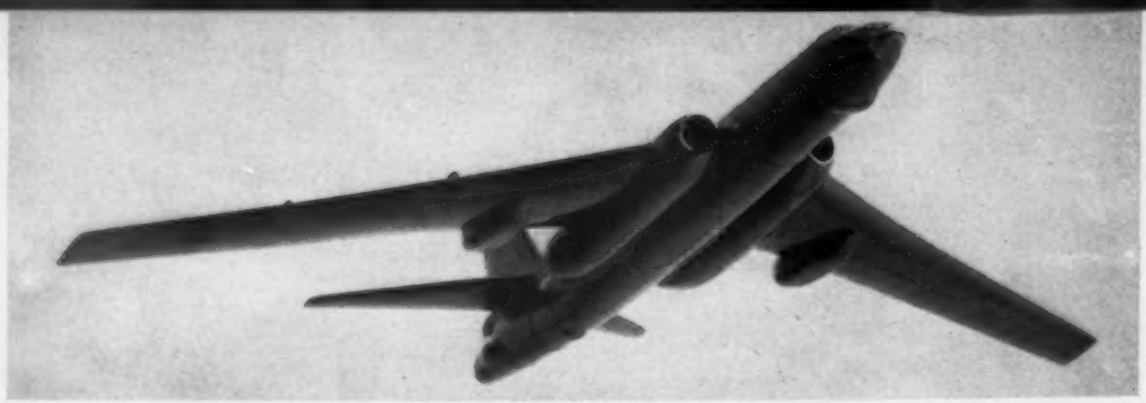
The Secretary of State for Air announced earlier this year that, with advanced versions of the Victor and Vulcan in prospect, orders for a number of Valiants had been cancelled. But, he added, the Valiant will provide an effective contribution to the deterrent for many years.

Handley Page Victor B.1 Some of the most recent news concerning this excellent bomber was forthcoming on the occasion of the opening last March of an expansion to the Handley Page factory at Radlett. Reporting this occasion (when five production Victors were seen together) *Flight* remarked: "Of the Victor itself, it is a tribute to the basic rightness of the design that, superficially, the production machine is barely distinguishable from the first prototype. In detail, however, the two aircraft are entirely different. It is now no longer merely a very advanced airframe, but an extraordinarily refined weapons system which will shortly be able to take its place as one of the most potent bombers ever placed in the hands of an air force." On the same occasion the Supply Minister said, "So far as we can judge, when the Victor gets into the hands of the R.A.F. it will be the equal in hitting power of any bomber in the world."

Flight's report continued: "Walking round the machine, the dominant impression is its very modest size, which completely belies its extraordinary all-round combination of range, load and performance. Production machines are powered by four very advanced Armstrong Siddeley Sapphire turbojets (and there is a strong possibility that at least one airframe will be converted to take the Rolls-Royce Conway by-pass engine). Production aircraft are longer than the prototype and have a cleaned-up design of vertical tail with a much smaller root intake and a revised form of 'acorn' at the junction of the fin and tailplane. Additional transparent areas have been added in the roof of the flight deck, and subtle changes have also been made to the intakes, the fuselage profile and the wing.

"The filling and grinding of all external surfaces, coupled with the

Boeing B-47E.



"Badger."

MILITARY AIRCRAFT 1956

Bombers

MEDIUM AND HEAVY

employment of sandwich-type construction," our report continued, "makes the Victor an exceptionally 'smooth' aircraft. There are many removable panels in the dorsal surface of the fuselage which are no doubt opened to admit the grab of a crane for loading weapons. There is an exceedingly large dielectric area beneath the cockpit floor and a corresponding area in the rear fuselage. Together these presumably serve an advanced radar-bombing system. Stick aerials project from above and below the rear fuselage and a small fixed tailwheel is fitted to act as a bumper. The take-off performance as we saw it last week is nothing short of brilliant, even allowing for the fact that the aircraft was not heavily loaded."

The design-thinking behind the Victor's crescent wing has been expounded in *Flight* on a number of occasions. The outermost panels of the wing have "droop-snoot" leading-edge flaps, each in two sections; the rearward-moving trailing-edge flaps are shaped to the jet-nacelle contours, and there are large hinged air-brake panels on the tail cone to increase drag for deceleration in flight and upon landing. The powered controls have progressive feel simulation.

Internal bomb capacity is obviously very great and additional bombs may be carried in streamlined containers beneath the wings.

Span, 110ft; length, 114ft 11in.

U.S.A.

Boeing B-52A Stratofortress Very few of these early-production B-52s were produced, the model having been quickly superseded by the "B."

Boeing B-52B Stratofortress This model was adaptable for multiple strategic rôles—delivery of conventional and nuclear weapons as well as photographic reconnaissance. Its gross weight was in excess of 350,000 lb, top speed more than 650 m.p.h., and operating height over 50,000ft. Maximum bomb load was well over 70,000 lb, and provision was made under the wings for external fuel tanks.

Boeing B-52C Stratofortress The "C" variant of the B-52 is built by Boeing at Seattle. Though of similar dimensions to the "A" and "B" (span 185ft and length 156ft), its all-up weight has been increased by some 50,000 lb to more than 400,000 lb, and provision is made for larger drop tanks (probably the largest in the world) than on the B-52B. The B-52C has reconnaissance capability.

Boeing B-52D Stratofortress The current Wichita-built model of the B-52, the "D," like the "C," has a gross weight of over 400,000 lb. Also in common with the "C," it has the larger drop tanks, but resembles the "A" rather than the "C" in being strictly a bomber, i.e., in having no reconnaissance capability. The first B-52D came off the "second source" Wichita line on December 7 last year—four months ahead of schedule. Initial cost is put at about $10 million, and the overall operating cost of a wing of 30 machines has been estimated as $39,290,000 annually.

A few weeks ago it was officially declared by the U.S. Secretary of Defense that the present rate of B-52 bombers was six a month. A peak production of 17 a month had been planned, but this had later been increased to 20.

Aerodynamic and constructional features were described at some length in our former review, but it may be recalled here that the powerplant is eight Pratt and Whitney J57 two-spool turbojets, "podded" under the wing, which is swept back at 35 deg. The turbojets can be of the F-19 or F-29 model, delivering up to 12,000 lb thrust for take-off with water injection.

The crew generally numbers six, five in the main nose compartment and one in the tail turret. Three of the forward crew-men have upward-ejection seats and two are ejected downwards. The tail gunner is thought to be jettisoned complete with his turret. The turret itself is of the radar-directed type, housing two or four 20 mm guns with a very large ammunition supply. An optical sight is also fitted. Earlier models had four 0.5in guns.

Accuracy of bomb delivery will be greatly enhanced on the B-52 by the MA-2, or BRANE system, developed by the International Business Machines Corporation. The name of this device signifies Bombing Radar Navigation Equipment. Originally conceived by the Air Research and Development Command at Baltimore, it is intended for

Douglas RB-66B.

the navigation of the aircraft to its target and for the automatic control of the bombing run. Operational details are, understandably, restricted, but the weight is 1,457 lb, bulk 30 cu ft and cost $300,000 (over £107,000). During the development period of the present equipment computors and related items were installed in "environmental chambers," there to be attacked by fungi, shaken by explosions, exposed to sleet and heavy rains, whipped by dust and subjected to extreme altitude conditions—all in temperatures ranging from minus 65 deg to 180 deg F. The BRANE system is said to have been developed with a sharp eye to reliability in view of frequent unserviceability with the earlier K-bombing system in the B-36 and B-47.

It would appear that BRANE is not the only bombing/navigation system used on the B-52, for the Sperry Gyroscope Company says that its MA-6A system and associated A-14 automatic flight control are likewise specified. (The MA-6A is described as a modified version of the K system.) It is further announced that the IBM system is scheduled to be adopted when suitable production models become available. This will be used on about half the B-52s now on order.

Provision is made, or is being made, in current B-52s for flight refuelling by the flying boom method, though "built-in" range is believed to be over 6,000 miles. For the present, however, the B-52 is handicapped by having to take its fuel from piston-engined KC-97s flying at some 25,000ft and 300 m.p.h. Thus, until the arrival of the jet-propelled Boeing KC-135s, which will be able to refuel up to 550 m.p.h. and 40,000ft, it must sacrifice some range in order to make contact with its piston-engined replenisher.

English Electric Canberra B.6.

English Electric Canberra B(I)8.

The B-52's take-off speed is lower than that of the B-47, acceleration is much the same, and the "52" cruises faster and higher. Accommodation is such that "short walks" are possible for relaxation. Control forces are slightly heavier on the "52," but considerably lighter than on other machines of comparable size. They are, in any case, light enough to be handled with one hand on the approach. The pilot has no aerodynamic indication of when the bomb doors are open. The undercarriage can be used as a speed brake at high Mach numbers, and the spoilers can be operated symmetrically for additional braking effect. Transitional crews, however, learn to apply the brakes with care, especially at high speed and high altitude, as sharp pitching moments can be inducted.

Boeing B-47E Stratojet The "E" model of the Stratojet continues in production at Tulsa (Douglas), Wichita (Boeing), and Marietta (Lockheed). It is expected, however, that the type will be phased out at the first two plants in December this year and at Marietta in March 1957. At the time of writing some 3,000 machines of the "E" and earlier sub-types must have been completed, and the requirements of Strategic Air Command were fulfilled several months ago. Surplus machines were then diverted to Tactical Air Command for the installation of "buddy system" air-refuelling kits.

"Built-in" range of the standard B-47E is considerably more than 3,000 miles, and this has been extended in recent months by the fitting of extremely large under-wing tanks, holding 1,870 U.S. gallons, which are jettisoned with the aid of 8ft parachutes. The conventional bomb load is about 20,000 lb and tests have been made from B-47s with Bell Rascal guided bombs. Defensive armament is two 20 mm guns installed in a remotely controlled tail turret developed by General Electric. In danger areas the turret radar is switched to "search" and if an attacking fighter shows on the screen it is automatically tracked until, having come within range, it is engaged by the B-47's guns. The B-47E is reported to have the Y-4 periscope bomb-sight, which device alone contains 3,433 parts.

For take-off the six General Electric J47-GE-25 turbojets give 7,200 lb thrust, with water injection, and this output can be augmented by the fitting of 33 assisted take-off rockets of 1,000 lb thrust each.

Span, 116ft; length, 106ft 8in; max. speed, about 630 m.p.h.; gross weight, about 202,000 lb.

Boeing TB-47J Stratojet A small number of these machines were built as crew-trainers for B-52s, having the MA-2 bombing system developed primarily for the larger machine.

Convair B-36J Nearly 400 B-36s of various models were built at Fort Worth before production ceased in 1954 and the type is expected to continue in service with Strategic Air Command until well into 1958. The "J" was the last of the "straight" bomber models and had a strengthened undercarriage permitting gross weights in excess of 400,000 lb. Powerplants are six Pratt and Whitney R-4360-53 piston engines and four General Electric J47-GE-19 turbojets, giving a top speed well over 400 m.p.h. and a service ceiling above 45,000ft. Range is officially quoted as 10,000 miles with 10,000 lb of bombs (dropped midway) and maximum bomb load is 84,000 lb. Sixteen 20 mm guns are installed in retractable turrets controlled by a General Electric central fire-control system. The crew numbers fifteen.

Span, 230ft; length, 162ft.

Convair B-58 Unofficially known as the Hustler, the B-58 is likely to be the world's first supersonic bomber. A delta, it has a wing of extreme thinness—probably of 4-4½ per cent thickness/chord ratio—and is powered with four General Electric J79 turbojets, each of about 15,000 lb thrust, podded two above and four below the wing. These are constant-speed engines and are said to give good acceleration and to provide full hydraulic power for the power-control system on the landing approach. Each pod has a central spike to force an inclined shock wave ahead of the automatically controlled air intake for efficient recovery of ram-air at supersonic speed. The fuselage is slender and houses a crew of two, the bomb load, fuel and the bogie undercarriage.

The original programme called for 30 B-58s, but this quantity is said to have been cut to 13 "because of anticipated performance difficulties." Of the 13 four are to have airborne electronic countermeasure equipment developed by Waltham Laboratories.

U.S.S.R.

"Bison" The Allied code-name Bison distinguishes a very large four-jet bomber, first observed in 1954 and now established in squadron service. Having a span of about 175ft, the wing is of high aspect ratio and carries in its inboard sections four staggered turbojets generally reckoned to be of some 15-18,000 lb thrust apiece. Gun armament appears to be carried in nose and tail stations. The main undercarriage is probably of the bogie type.

"Bear" A somewhat smaller machine than Bison, having a span of perhaps 145-150ft, the Bear distinctly resembles the Boeing B-52 in layout but is unique among bombers in having four turboprops, driving counter-rotating airscrews. Extensions of the inboard nacelles are thought to house the main undercarriage units.

"Badger" This counterpart of the Boeing B-47 is thought to have been in service since 1953 and a formation of over 50 was seen in public last July. The wing, powerplant installation and tail are essentially similar to those of the now-familiar Tu-104 transport.

Only two turbojets are fitted—snugly into the fuselage flanks—and they are thought to be rated at 15,000-18,000 lb thrust. The stalky, bogie undercarriage units retract rearwards into nacelles on the trailing edges of the wing, and provision is made on the Tu-104 for a braking parachute. Maximum speed of the Badger may be nearer 600 than 500 m.p.h. and range is probably in excess of 3,000 miles. Bombing radar is installed, and there is a manned tail turret, presumed to house 20 mm armament.

Span, about 120ft; gross weight, over 120,000 lb.

"Bison".

MILITARY AIRCRAFT 1956

Bombers

TACTICAL AND INTRUDERS

GREAT BRITAIN

English Electric Canberra B.6 Extensively in service with R.A.F. light-bomber formations, the Canberra B.6 is a development of the B.2 and is now passing out of production. The Rolls-Royce Avon turbojets are of the RA.7 series, and internal fuel tankage is increased over that of the former mark. Maximum speed is thought to be superior to 600 m.p.h. and service ceiling of the order of 50,000ft. The crew numbers three (pilot, navigator/plotter, observer).

Canberra bombers have been exported to Venezuela, Ecuador and Peru, and a few B.6s have been serving in France for experimental work. In Australia the B.20 (generally resembling the B.6) is already backed by a good operational record.

Span, 64ft; length, 65ft 6in.

English Electric B(I).6 A number of B.6s have been converted on the production line to carry the gun pack and wing pylons first introduced on the prototype B(I).8. These machines are in service with the 2nd Tactical Air Force in Germany.

English Electric Canberra B(I).8 Generally classed as an "interdictor" (hence the "I" in the designation), this machine was developed to meet an R.A.F. requirement and has already been referred to under "Ground Attack." The forward fuselage is wholly new in design and is arranged for visual bombing with a crew of two, the navigator being seated ahead of the pilot, who is seated under a fighter-type canopy offset to port. Various weapons can be carried internally and on underwing pylons. The four 20 mm guns are removable as a package from the rear weapons bay, and the forward bomb doors are specially stiffened against gun blast.

Operational rôles of this outstandingly versatile machine are night interdictor, high-altitude bomber, target-marker or reconnaissance aircraft.

U.S.A.

Douglas B-66B A companion type to the RB-66B reconnaissance machine and to the naval Skywarrior, this bomber has two Allison J71-A-11 turbojets (earlier models had the J71-A-9) and weighs 40,330 lb empty and 78,000 lb all-up. Overload gross weight is 83,000 lb. The type is distinguishable from the Skywarrior by its centre-section of increased chord, longer nacelles and modified cockpit. Fuel is carried in the wings and fuselage and in auxiliary under-wing tanks, and Tactical Air Command of the U.S.A.F. are interested in having tanker kits to refuel other B-66s or fighter/bombers. Two 20 mm guns are mounted in an unmanned tail turret for which General Electric fire-control gear is provided. A crew of three is normal, and they are housed together in the forward pressurized compartment. Features include a single-point refuelling system and thermal-cyclic de-icing system for the wing and tail surfaces.

Span, 72.5ft; length, 75.1ft.

"Bear".

Martin B-57B This American-developed version of the English Electric Canberra is a light bomber and night intruder, and is immediately identified by a large rear-hinged jettisonable canopy which houses the tandem-seated crew of two (pilot and radar operator/navigator/bomb-aimer). Another innovation is the mounting on the rear fuselage of hydraulically operated air brakes, additional to the finger-type brakes on each wing. The turbojets are Wright J65-W-5s (Armstrong Siddeley Sapphire licence) rated at 7,200 lb thrust each. Gross take-off weight is about 50,000 lb, range well over 2,000 miles, and maximum speed considerably in excess of 600 m.p.h. Guns—4 × 20 mm or 8 × 0.5in—are mounted in the leading edge, and the bombs are carried in the Martin rotary bomb bay.

This ingeniously contrived bay is in the form of a rotating platform on which the bombs are carried. The under-side forms the under surface of the fuselage, and the whole can be rotated about its fore-and-aft axis, thus exposing the bombs without creating a large opening in the fuselage. To ensure that a bomb does not tumble or strike the aircraft, it is "kicked" out of its shackle by two air-actuated plungers and a radius arm. For loading, the entire platform is lowered from the aircraft, mounted on wheels and taken to the bomb dump. It is hoisted back into position by three standard bomb hoists. Possible under-wing loads are sixteen 5in rocket projectiles or four pylon-mounted bombs or napalm tanks.

The B-57Bs have given exemplary service in U.S.A.F. squadrons and distinguished themselves particularly in Exercise Sagebrush last year. Our contemporary, *Aviation Week*, interviewed one of the pilots and reported in these terms: "Deitsch points out that a light jet bomber on a low-level operation consumes fuel at a high rate. At 45,000ft this situation is corrected and the speed is very fast. 'I run away from fighters,' Deitsch says. 'The B-57 would make a good intercepter at that altitude.' On most missions, he carries fuel for about six hours. Oxygen is carried in liquid form; the supply is sufficient to last eight hours.

"Present B-57s carry SHORAN, which Yanovitch [the navigator] says is fine electronic goods for his actual bombing runs. But he misses a good airborne radar, feels strongly that there would be an improvement in the plane's potential if he had it. Yanovitch believes radar would permit better utilization of the B-57's maximum range possibilities and still do a good job on the target when linked to the bombing system. His idea has endorsement from higher levels. The Martin company has offered a proposal to U.S.A.F. for incorporation of a bombing and navigational radar to be carried along with SHORAN. Accuracy of the present equipment makes U.S.A.F. reluctant to drop it. While S-ORAN'S range is limited, a competent operator can hit within a 400ft circle from 40,000ft. A second Martin proposal, it was learned, is for the installation of a rudder boost to make the B-57 more manœuvrable at low speeds, particularly when performing on one engine. Single-engine performance is reported good, but speed is critical."

Span, 64ft; length, 65ft 6in.

Martin B-57C This model duplicates the "B" version in appearance, performance and purpose, and differs only in having dual controls, which suit it for use as a trainer.

FRANCE

S.N.C.A.S.O. 4050B Vautour This bomber version of the Vautour carries from one to ten bombs internally (alternatively, guided missiles or an auxiliary fuel tank) and additional bombs or missiles or tanks (2 × 110 gal) under the wings. There is a visual bomb-sighting station in the nose.

It is claimed that the bombing platform is absolutely stable, even at the highest altitudes, and it has been proved that the opening of the bomb bay, preparation for bomb release, and the release itself, occasion no trim change even at transonic speed (all versions of the Vautour exceed Mach 1 in the dive).

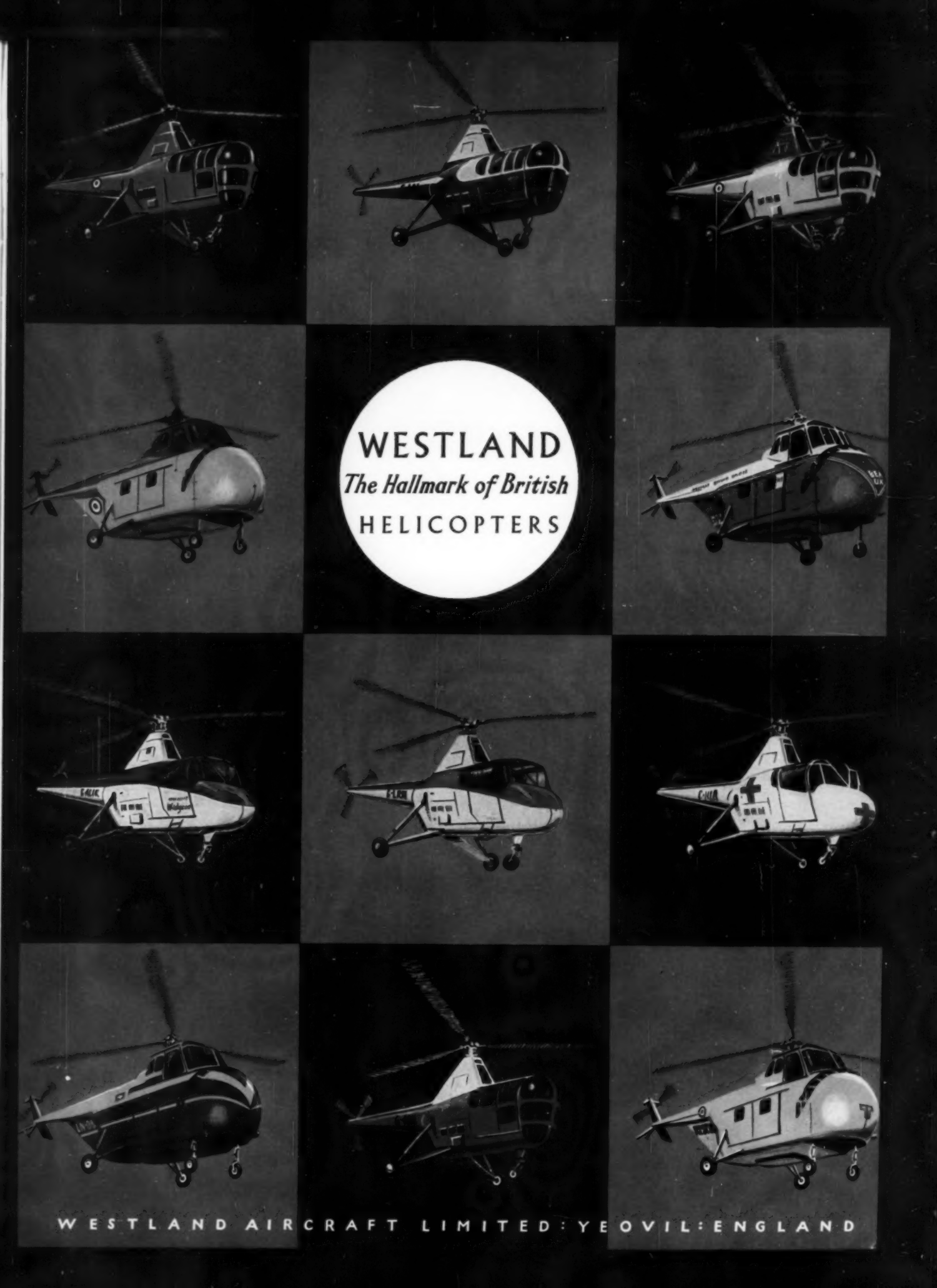
With normal load the Vautour can take off and land in less than 2,650ft. A ribbon-type braking parachute is stowed in the rear fuselage as standard equipment.

U.S.S.R.

Il-28 Bearing the Allied code-name "Beagle," this is a standard light bomber in the Soviet and satellite air forces. The two turbojets (Rolls-Royce Nene development) are housed in very large underslung nacelles, into which the main undercarriage wheels retract. Fixed guns are carried in addition to movable guns in a tail turret, and the crew is thought to number three. The pilot has a fighter-type canopy, and the bomb-aimer's position is generously provided with windows. Wing-tip tanks can be fitted and a trainer version has been developed. Maximum speed is probably less than 600 m.p.h.

Span, 65ft.

"Beagle" A naval attack bomber ascribed to A. N. Tupolev, this is laid out along the lines of the Il-28. Only small quantities are thought to have been built, and the type may no longer be in service.


WESTLAND
The Hallmark of British
HELICOPTERS
WESTLAND AIRCRAFT LIMITED: YEOVIL: ENGLAND

In Canada

See if YOU can qualify at C.D.C.

as an

ENGINEER, PHYSICIST or MATHEMATICIAN

If you are confined to one minor aspect of an overall programme and want to get away from job limitations, there is room at Computing Devices of Canada Limited for your creative thinking . . .

C.D.C. is an independent, privately owned, all-Canadian Company, specializing in custom built electronic and electro-mechanical equipment. Operations are mainly in the fields of aircraft instrumentation, simulation, guided missile analysis, electronic computers and semiconductor applications . . .

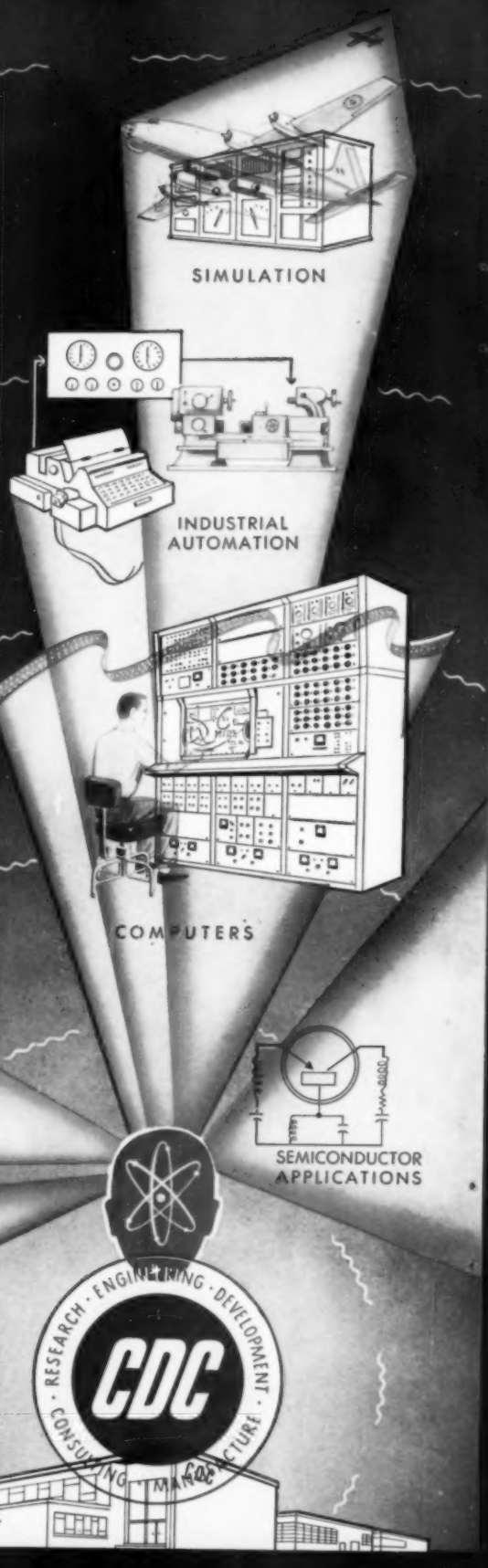
Being a medium sized Company, mainly engaged upon widely diversified development projects, engineers have outstanding opportunities for creative work in a new modern plant where FULL RECOGNITION is accorded . . .

Personnel have excellent opportunities to advance by continuing their PROFESSIONAL EDUCATION . . .

At C.D.C. you receive excellent wages, paid vacations, holidays and sick leave, retirement plan and group insurance for the whole family. Housing is readily available in the delightful Ottawa Valley where the per family income is the second highest of all large Canadian cities . . .

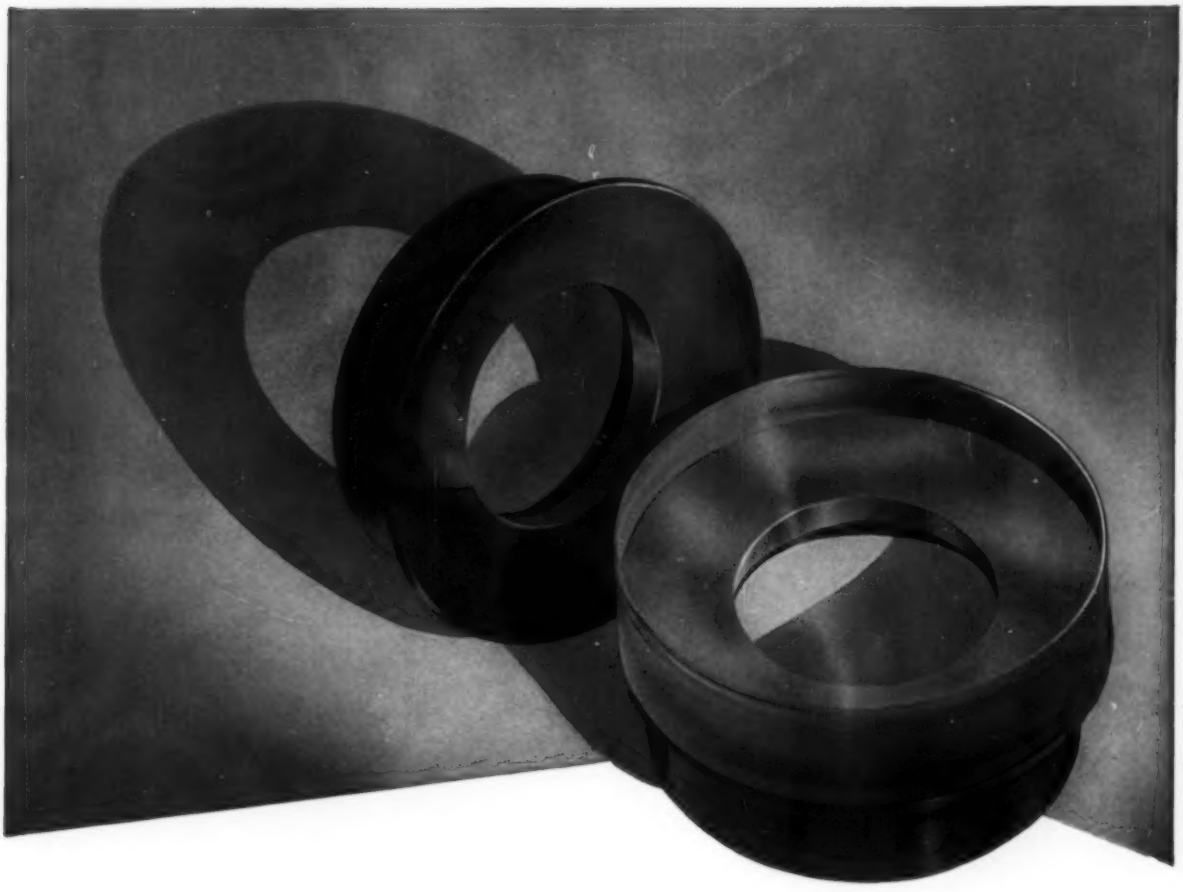
For further information and employment brochure, write in confidence to the Personnel Manager, giving details of experience and qualifications. All replies will be held in strict confidence.

5406R



COMPUTING DEVICES OF CANADA LIMITED

P.O. BOX 508 • OTTAWA • CANADA



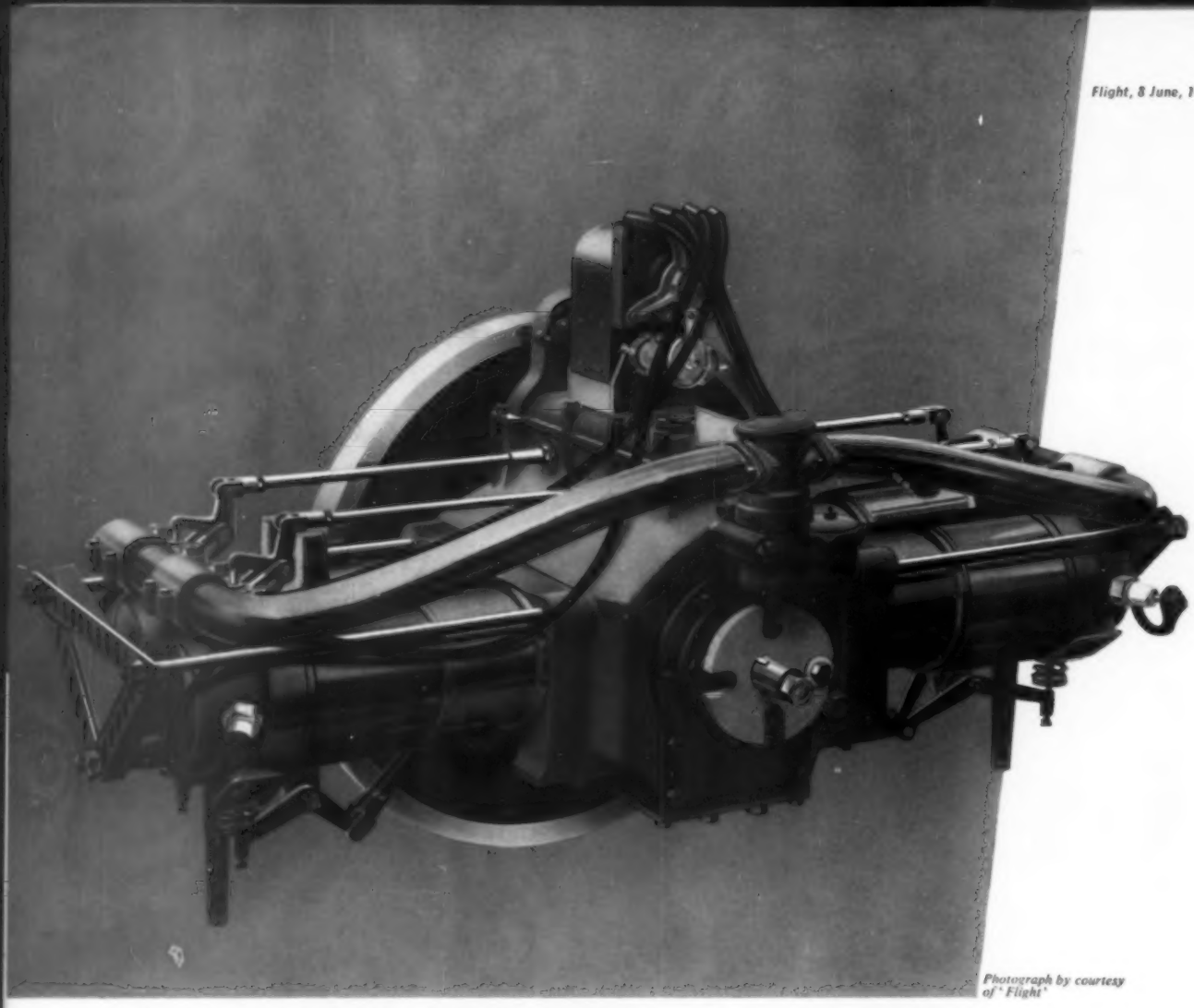
The optical maker's art is applied in producing camplates of super finish and accuracy for 2,000 p.s.i. fuel pumps. Three basic pumps cover present engine requirements with deliveries of 460 to 2,800 gallons per hour.

FUEL AND COMBUSTION SYSTEMS FOR GAS TURBINE ENGINES

LUCAS

JOSEPH LUCAS (GAS TURBINE EQUIPMENT) LTD., BIRMINGHAM & BURNLEY

Lucas-Rotax (Australia) Pty. Ltd., Melbourne and Sydney, Australia.
Lucas-Rotax Ltd., Toronto and Montreal, Canada.



Photograph by courtesy of 'Flight'

ON SEPTEMBER 10th, 1910 ...

. . . a strange new machine—a "flying" machine so it was whispered locally—was pushed from the secrecy of a shed on Seven Barrows. Unheralded, one of aviation's great pioneers made history, vividly recalled in the words of an eye-witness . . . " Mr. de Havilland mounts carefully into the seat at the front, for these machines are fragile although constructed with much scientific accuracy, and the word is given to stand clear, for it would mean certain death to come into contact with the blades circling at a thousand revolutions a minute. A moment's hesitation, a lot of blue oily smoke, and the biplane gathers way. At first very slowly it bumps along the ground, but with the increasing speed denoted by the higher hum of the propellor, and the quicker bangs of the exhaust . . . a quicker speed, more smoke, more noise, and at last it is clear and immediately the pace through the air increases. The speed is great, possibly thirty miles an hour . . . !" *

The Iris engine powering the de Havilland biplane was Geoffrey de Havilland's own design and an early example of the horizontally opposed flat-four. A thermo-syphon cooling system and H.T. magneto were employed, and, with a bore of 114 mm. and stroke of 120 mm. the engine developed 52 b.h.p. at 1,500 r.p.m. for a weight of 230 lb. (including the 30 lb. flywheel). A single camshaft operated hollow push-rods and bell-crank levers to the vertically opposed inlet and exhaust valves, the exhaust rods passing diagonally down between the connecting-rods. Cast iron cylinders and machined steel pistons were used with Hoffman ball-bearings for mains, big-end and end bearings; these bearings greatly simplified lubrication—often a problem with the simplest engines.

But for answers to fuel and lubrication problems on to-day's—and tomorrow's—aero-engines why not get in touch with Esso ?

* Extract from *Newbury Weekly News*, September 22nd, 1910.

It pays to consult

Esso

ON ALL FUEL AND LUBRICATING PROBLEMS

ESSO PETROLEUM COMPANY LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1
AVIATION TECHNICAL SERVICE, RELIANCE 1261

RECONNAISSANCE

UNDER the sub-heading "Long Range" we group those high-flying long-distance reconnaissance machines designed for deep penetration into enemy territory and generally classed as "strategic." The short/medium-range class also embraces a number of machines suitable for strategic work (especially the Ficon Thunderstreak and the McDonnell Voodoo), but is mainly comprised of the relatively low-level short-distance single-seaters charged with obtaining information for the army and for the tactical air force. In the R.A.F. these are known as fighter-reconnaissance aircraft, being adapted, like others of their kind, from standard types of fighter.

Some significant conclusions were reached at a "reconnaissance symposium" held last year at the Headquarters of Northern Forces Central Europe. An individual trend in photographic reconnaissance methods was then apparent: pilots, it was disclosed, were no longer always instructed to let their cameras "run free" while they were over enemy territory, but rather to photograph the target area only. This, together with increased selectivity in the processing units, considerably reduced the time delay between the landing of the aircraft and the arrival of target information at the intelligence centre of the striking force. The principle of reconnaissance was now such, it was said, that in the face of modern weapons a few photographs of the right area at the right time could be worth more than the 120,000 required for the launching of the final offensive in Italy. An official statement ran: "Progress is also being made in the problem of bad weather. It has been worked out that daylight photography is limited to one-sixth of the month because of bad weather, but that the period for night photography is considerably longer. There is, therefore, a new emphasis on the development of night reconnaissance."

At about the same time a new reconnaissance system was announced in America and was reported to be capable of providing a clear sharp picture of ground activities "under the poorest lighting conditions at night." Details were reported by *Aviation Week* in these terms: "The system, called 'cat eye,' resembles a closed-circuit TV, employing both a television type camera and a cathode ray tube viewing screen. However, it is reportedly 1,000 times more sensitive than a conventional type television camera. The basis of the system is an 'optical amplifier,' which provides a major increase in contrast ratio between varying shades of grey and black. Flight tests on an experimental system, a Wright spokesman said, showed that 'airborne observers were able to see the ground clearly on a moonless, winter night.' Westinghouse Electric Corp. and the Radio Corp. of America presently are developing improved models of the optical amplifier. ARDC says the device is expected to become an invaluable aid for night-time aerial reconnaissance. A photoelectric cell is used to convert the available light into electrons, which in turn are accelerated and used to produce electrostatic charges on an intermediate screen or plate. Here the signals are amplified, to increase the contrast ratio between varying shades of grey, and then sensed by an electron beam which is amplified to produce a signal which is displayed on a cathode ray tube. (The process appears to be an adaptation of storage-type cathode ray techniques which RCA and others have developed for other uses.)"

Within the past few weeks the Philco Corporation announced that it had developed a television system by which pictures of troop movements could be relayed from a supersonic single-seater aircraft for showing on screens of cinema size at ground control points. An announcement ran: "It now is possible to transmit a TV picture, not only from near ground level, but from the stratosphere. . . The scope of such a reconnaissance system is almost unlimited. Unlike those systems which have been used commercially to relay TV signals from one ground point to another, by way of a slow-circling plane, the new system is a complete, self-contained, broadcasting station. It is so compact that it may be carried in single-seater aircraft. When a wide area is to be covered, two TV cameras are mounted in a plane and are operated mechanically. Signals are transmitted to a ground control receiver for instantaneous photographing on film that can be processed in less than a minute. The pictures can then be shown on screens or relayed. Pick-ups from slower-moving planes can be observed 'live' on standard TV monitors."

A Philco spokesman claimed that the difficulties of obtaining clear, sharp pictures with cameras carried at supersonic speeds had been overcome. This was done with the development of a unique transmitter, he said, and it was now possible to slow, or stop TV pictures taken at high speeds without a blur of ground movement.

From America, too, came other disclosures, and publication of a picture which showed with astounding clarity individual rivets on the wing surface of an aircraft photographed at a speed of 450 m.p.h. and at a height of 100ft. It was reported that the specialized camera systems developed for modern high-speed aircraft include equipment that compensates for image motion (a "must" in supersonic reconnaissaince), integral viewfinders, high-altitude scanners (the scanning system senses the speed: altitude ratio, and automatic photogrammetric intervalometers.

Most significant, perhaps, it was remarked that whereas today 10 per cent of all military combat aircraft being built were reconnaissance versions of fighting types, the work had become important enough for the U.S. Air Force to call for a high-speed aircraft built especially for such work.

English Electric Canberra P.R.7.

English Electric Canberra P.R.9.

LONG-RANGE

GREAT BRITAIN

English Electric Canberra P.R.7 This seventh mark of the Canberra is a development of the P.R.3, having additional fuel and Rolls-Royce Avons of a later mark. Like other P.R. Canberras now in service, it is equipped either with a "fan" of six 36in Williamson F.52 cameras or a similar arrangement of four 20in F.52s plus, in each case, one vertical 6in F.49. These cameras are claimed by their makers to enable the Canberra "to photograph effectively from heights up to at least 50,000ft." It may appropriately be mentioned here that a new high-altitude reconnaissance camera, known as the F.96, is now in quantity production at the Williamson works for the R.A.F.

English Electric Canberra P.R.9 The newest photographic reconnaissance variant of the Canberra, the P.R.9 has an increased wing span (68ft) and much increased wing chord inboard of the nacelles. The auxiliary fuel tanks are now slightly inset. Late-mark Rolls-Royce Avons are fitted. Ceiling is possibly of the order of 60,000ft.

Vickers-Armstrongs Valiant B(PR).1 Distinguished by this designation is a photographic reconnaissance version of the Valiant, readily convertible to perform the bomber rôle. It has bomb-door windows for vertical cameras and two rear-fuselage windows for "obliques."

U.S.A.

Boeing RB-47E Stratojet A standard strategic-reconnaissance aircraft of the U.S.A.F., the RB-47E differs from the B-47E in having a lengthened nose and an air-conditioned camera compartment. There

Boeing RB-47E.

MILITARY AIRCRAFT 1956

Reconnaissance

LONG-RANGE

are positions for 16 cameras and any seven can be carried at one time, depending on the nature of the mission. Flares and flash bombs are carried in the bomb bay and intervalometers make it possible to take continuous pictures of large areas at regular intervals. Other equipment includes an optical viewfinder and photo-cell-operated shutters actuated by the light of flash illuminants for night photography.

Boeing RB-47K Stratojet The RB-47K version of the Stratojet has been specially modified for Strategic Air Command to undertake both weather reconnaissance and photography. The crew, as in other Stratojets, numbers three. Special equipment measures and records wind velocities and directions, moisture, temperatures and barometric pressures, and to maintain a permanent record the weather instruments —located on a single panel in the nose—are photographed at regular intervals. Data can be correlated with cloud photographs (also taken at regular intervals) for predictions of weather, or under certain circumstances can be relayed to base immediately. Additionally the RB-47K can undertake high- or low-altitude photographic missions by day or night.

Boeing B-52 Stratofortress The bomb bays of the B-52B and C can accommodate a pressurized capsule, resembling a boiler, with stations for a two-man crew and having provision for four cameras. A makers' mention of "interchangeable electronic equipment and antennas" suggests also a countermeasures function.

Convair GRB-36/Republic RF-84K Ficon The purpose of the Ficon (fighter conveyor) combination, whereby a fighter/reconnaissance aircraft is carried and launched by a "mother ship," is officially described as "to provide the air force with the capability of long-range high-speed reconnaissance with a high probability of survival for personnel and equipment." The RF-84K Thunderflash is a special modification of the RF-84F. The intake ducts are in the wing roots and the nose is lengthened to permit installation of a "sweeping variety of cameras, radar and top secret electronic equipment." In addition to several special night cameras there are 15 standard cameras available for installation. It is claimed that the Thunderflash is "the first reconnaissance aircraft equipped with the whole combination of aerial cameras plus the dicing camera for close-up photos of individual targets." It is also said to be the first fighter-type aircraft to be equipped with the tri-metrogon camera, which takes horizon-to-horizon pictures.

The tailplane of the Thunderflash is given negative dihedral to permit stowage in the GRB-36 and a retractable nose hook and fuselage pins are fitted for attachment to the trapeze of the large aircraft. Additional "special radar" (doubtless to facilitate a meeting under unfavourable conditions) has been installed.

A Republic announcement runs: "On a typical Ficon mission the Thunderflash and GRB-36 will take off separately and rendezvous for a mid-air hook-up. The fighter approaches the trapeze mechanism which has been lowered from the mother plane. Gradually closing the gap between the two planes, foot by foot, the Thunderflash gently engages its nose hook onto the boom. The fighter pilot then lowers his wing flaps to make the aft part of his plane rise. A hydraulic mechanism retrieves the steel boom to draw the fighter closer to the bomber's fuselage until side latches on the trapeze lock onto the Thunderflash fuselage pins and hold the smaller plane steady. Then the trapeze raises the fighter into the bomb bay. The Thunderflash pilot can climb out of his cockpit and enter the bomber by means of a catwalk. With the Thunderflash snuggled in its belly the GRB-36 would proceed around the globe to the fringes of the target. Then, lowering the RF-84K, the Thunderflash pilot would cut loose and proceed to the target area to accomplish the mission. A later rendezvous and hook-up gives the Thunderflash pilot his hitch-hike home."

At night the two pilots make their rendezvous by radio, and the pilot of the Thunderflash lines up his machine with the bomber's formation lights. The bomb bay of the GRB-36 is illuminated and a spotlight picks out the trapeze.

The RF-84K is armed with four 0.5in guns and has a range of about 2,000 miles. The GRB-36 carries B-36 bomber armament and has a range of some 10,000 miles.

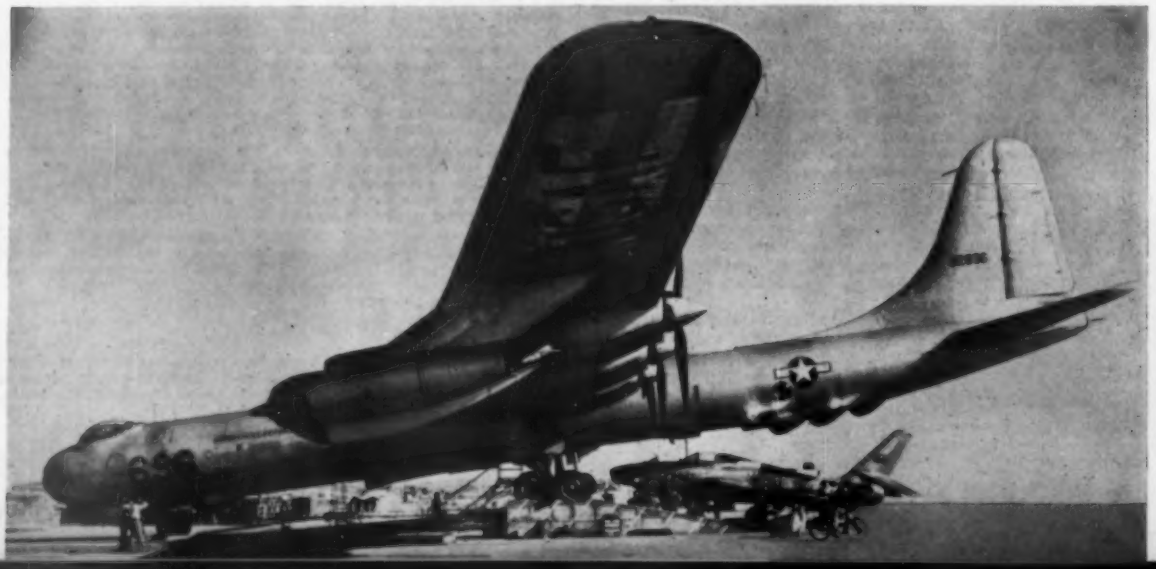
Convair RB-58 Hustler A reconnaissance system for this version of the B-58 supersonic bomber is in pilot production at Fairchild and is said to include "three 9 × 9in and three 9 × 18in cameras, one 70 mm forward facing image motion compensation camera, and two alternate co-installations—a single 70 mm downward aiming camera or a fan of five downward facing 70 mm cameras." The television closed-loop viewfinder is said to have an azimuth sweep of 45 deg right and left, elevation control from straight ahead to 90 deg down, fields of view of 10 and 40 deg, and a light range of 0.5 to 8,000 foot-lamberts.

Douglas RB-66B and C These are reconnaissance variants of the basic B-66 powered, like the "B," with Allison J71-A9s or 11s and having maximum speeds "between 600 and 700 m.p.h." Altitudes "up to 45,000ft" are attainable and the range is such as to "permit deep penetration into enemy territory for all-weather, around-the-clock, photographic and mapping missions." The two 20 mm guns, remotely controlled by means of General Electric equipment, are retained. Empty weight of the RB-66B is 39,686 lb, gross weight 70,000 lb, and overload gross weight 79,000 lb. It is reported that the RB-66 will be the last reconnaissance bomber for Tactical Air Command of the U.S.A.F. and that in future adaptations of fighter or "special designs of fighter performance" will be utilized.

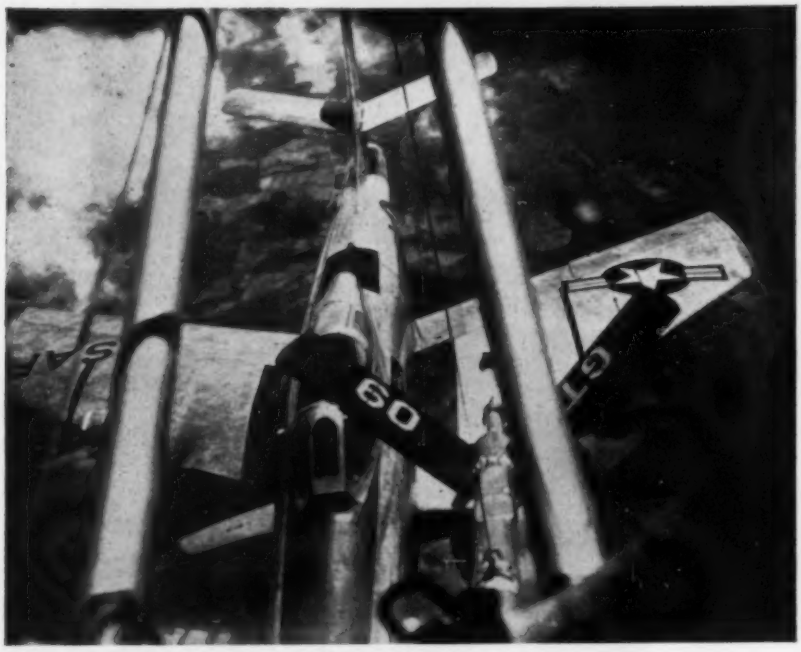
Martin RB-57B This reconnaissance version of the American-built English Electric Canberra is serving in the United States and with the Tactical Air Command of the U.S.A.F. in Germany. The crew numbers two (pilot and photographer/navigator).

Under "Bombers" we quoted from *Aviation Week's* report on the B-57 bomber in Exercise Sagebrush. Reviewing reconnaissance operations the journal reported: "Reconnaissance pilots of the 363rd find the B-57 a big improvement over the B-26, mainly because of its speed.

Convair GRB-36 taking aboard a Republic RF-84K Thunderflash.



Reconnaissance Close-Ups



A Republic RF-84F Thunderflash refuelling from a Boeing KB-29 tanker.

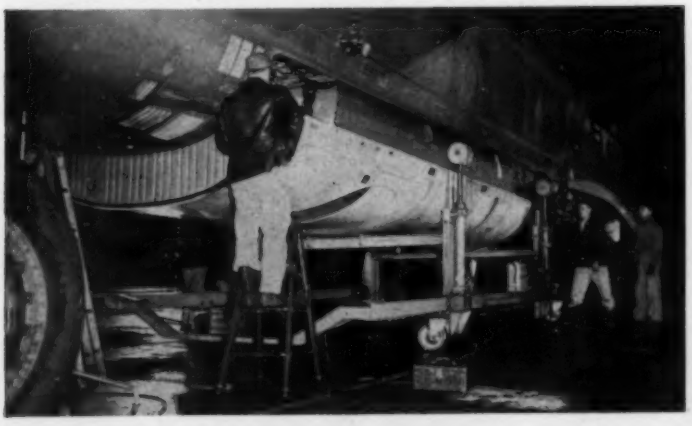
Sighting the cameras of a Canberra P.R.7.

Camera ports, attachment hook, and tanks on Republic RF-84K.

Loading the reconnaissance "capsule" in the bomb bay of a Boeing B-52B.

Camera ports on the supersonic McDonnell RF-101A Voodoo.

Camera installation on Lockheed RT-33A.



McDonnell RF-101A.

MILITARY AIRCRAFT 1956

Reconnaissance

LONG RANGE

Typical Sagebrush mission involves a flight of about 1,500 miles over five targets, lasts four and a half hours. Some 15 to 20 pictures are taken of each target from flares at an altitude of 20,000ft. The prints are made at Randolph in mobile air-transportable trailers, brought here from Shaw A.F.B., S.C., in C-124s of the 18th A.F. Twice-a-day courier service flies the finished prints to Aggressor headquarters at England A.F.B., La., nearly 400 miles away. It takes eight C-124s to move the reconnaissance outfit, partly because the trailers are not economical packing cases. On the other hand, the darkroom equipment is set up ready for action and finished prints can be supplied quickly once they are unloaded at a new base.

Martin RB-57D Described as a test-bed for the Pratt and Whitney J57 two-spool turbojet, this may well be the precursor of a long-span reconnaissance development of the Canberra for the U.S.A.F.

North American AJ-2P Savage The duties of this heavy carrier-borne reconnaissance aircraft may eventually be taken over by the Douglas Skywarrior (see under "Carrier-borne Strike"). It is powered by two Pratt and Whitney R-2800 piston engines and one Allison J33 turbojet, and has a maximum speed of about 425 m.p.h. Eighteen different cameras are available for installation for night or day photography, and seven of these can be installed at any one time. Photo-flash bombs are carried in the bomb bay for night reconnaissance.

SHORT- AND MEDIUM-RANGE

GREAT BRITAIN

Hawker Hunter F.R.4 Basically an F.4, this machine has a nose cap of normal contour but detachable to expose no fewer than six cameras, two looking sideways, two downward oblique, one forward oblique, and one straight ahead. The aircraft carries the standard 4 × 30 mm gun pack and gun camera but no radar-ranging sight.

Vickers-Supermarine Swift F.R.5. The Swift is now in service with fighter/reconnaissance squadrons of the Royal Air Force, and is well equipped for the duty by virtue of its high speed at low level and the rapid acceleration conferred by the Rolls-Royce Avon turbojet with afterburner. Internal fuel capacity is great and a 220-gal jettisonable tank can be attached beneath the fuselage. The cockpit canopy is of a new clear-view type, and the armament has been reduced to two 30 mm guns. Three reconnaissance cameras are normally installed.

U.S.A.

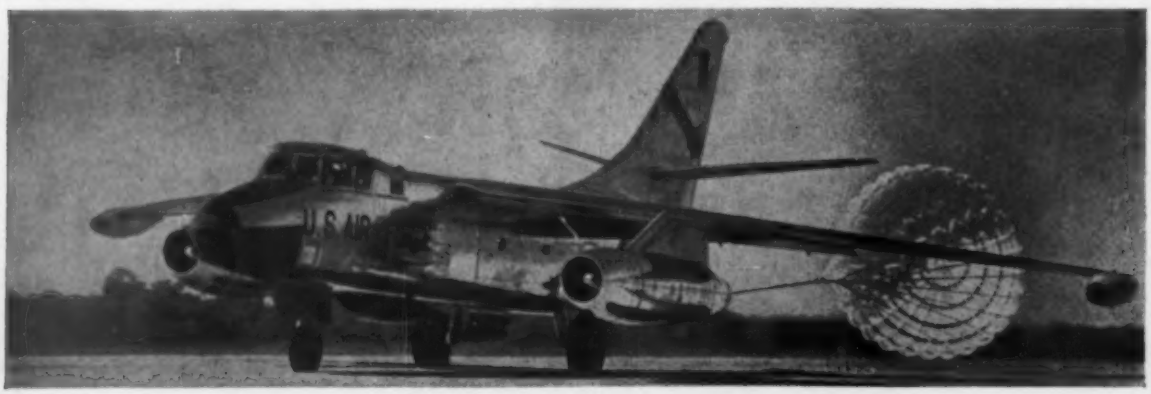
McDonnell RF-101A Voodoo The world's fastest reconnaissance aircraft, the RF-101A should achieve maximum speeds of the order of 1,000 m.p.h. It differs from its fighter prototype in weighing less and in having a lengthened nose compartment, air-conditioned and housing automatically controlled cameras.

Vickers-Supermarine Swift F.R.5.

Republic RF-84F Thunderflash The standard RF-84F is essentially similar to the RF-84K Ficon machine, and though its operational radius is, of course, less, it is equipped for in-flight refuelling and is claimed to be capable of "global reconnaissance missions duplicating the 5,118-miles non-stop record flight of Thunderstreaks from London, England, to Texas in 1955." It is known to carry a large number of magnesium flares in flash ejector cartridges under the wing and is the first machine of its class to have a camera control system and viewfinder for the pilot. A makers' announcement states: "An automatic computer in the camera control system analyzes factors of light, speed and altitude and automatically sets the cameras. This virtually eliminates camera error and accounts for the clear, sharp photos taken by the RF-84F from as high as seven miles up. The viewfinder enables the pilot to see exactly what he is photographing so that, for example, in following a grid pattern he can spot landmarks to gauge his 'edges' and compensate for wind drift of the aircraft. The Thunderflash is also equipped with a wire recorder which the pilot uses for making 'notes' while taking pictures or for visual reconnaissance missions.

Chance Vought F.7U-3P Cutlass This version of the Cutlass is the fastest carrier-borne reconnaissance aircraft in service, and carries oblique and vertical cameras in a specially modified nose. Auxiliary fuel tanks are normally carried on the inboard under-wing pylons.

Douglas RB-66C.



Avro Shackleton M.R.3.

MILITARY AIRCRAFT 1956

MARITIME RECONNAISSANCE

FOR the first time in one of these surveys we have segregated the radar picket aircraft under a separate—subsequent—heading; but there still remains in the present classification that odd-man-out the Martin XP6M-1 SeaMaster high-speed flying-boat. Though capable of "maritime reconnaissance" in a narrow sense, this is primarily a strike weapon and, more particularly, a mine-layer. It is notable, too, as being the sole modern military flying-boat on order, for the once-hoped-for turboprop machines of Saunders-Roe and Short remain on paper.

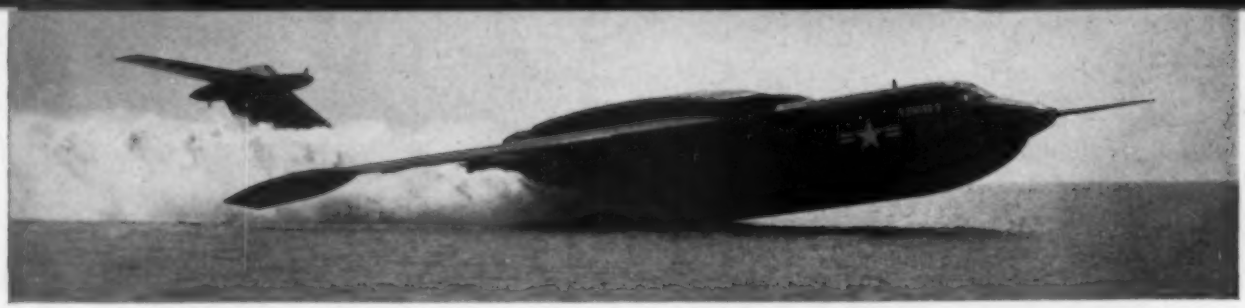
The present class, then, is mainly composed of land-based machines, unpressurized, heavily manned, piston-engined, and of very long endurance. Their primary task is the detection and destruction of submarines and surveillance of shipping. Primary weapons are torpedoes (especially of the homing variety), air-to-surface and air-to-under-water missiles, bombs, sea mines and depth charges, and equipment includes not only detection radar but magnetic airborne detection gear as well as sonobuoys and various kinds of floats.

Of particular significance is the recent introduction by the U.S. Navy of the Fairchild Petrel air-to-surface missile, two of which can be carried by a Neptune. It is claimed for this weapon that it "partially supplants the piloted attack plane of World War II." Such machines, it is recalled, performed one of the most hazardous missions of that war. Since the Petrel's method of approach to the target minimizes the enemy's chances of detecting and destroying it, it is claimed that potential loss of highly trained pilots as well as costly aircraft and equipment is largely eliminated.

GREAT BRITAIN

Avro Shackleton M.R.3. The design of the Shackleton maritime-reconnaissance aircraft dates from early 1949 and many scores of the marks M.R.1 and M.R.2 have been delivered to R.A.F. Coastal Command. These two earlier marks differ principally from the third (for the R.A.F. and the South African Air Force) in having a tailwheel undercarriage, and it has been stated that this arrangement was chosen in order to obtain the maximum utilization of the space available in the nose for operational equipment. Weapons stowage was also facilitated.

Lockheed P2V-7 Neptune.



Martin XP6M-1 SeaMaster

MILITARY AIRCRAFT 1956

Maritime Reconnaissance

The M.R.3 is essentially similar to the M.R.2 but has a nosewheel undercarriage and increased fuel capacity, by virtue of auxiliary wing-tip tanks. The pilot's canopy is of the clear-view type and changes have been made in internal equipment. There are two 20 mm nose guns aimed by a gunner, who sits above the bomb-aimer, but there is no dorsal turret. The M.R.3 carries a crew of ten comprising a captain, co-pilot, two navigators, engineer and five signallers. There is a galley and a soundproofed wardroom where crew-members may rest when not on duty. Little technical information concerning the M.R.3 has been released but the maximum take-off weight of the M.R.2 is 86,000 lb. The engines are four Rolls-Royce Griffons driving de Havilland six-blade, contra-rotating, constant-speed, fully feathering airscrews.

A distinctive installation on the Mk 3 is the retractable radar aft of the bomb bay. All versions carry a heavy load of bombs, depth charges, sonobuoys, or other anti-submarine or anti-surface-vessel stores, and alternative provision is made for an air/sea-rescue lifeboat.

Span, 120ft 6½in; length, 87ft 4in.

CANADA

Canadair CL-28 The largest aircraft ever built in Canada, the CL-28 is a special unpressurized low-level maritime-reconnaissance development of the Bristol Britannia, powered with four Wright Turbo-Compound reciprocating engines. The initial contract for 13 aircraft was placed in February 1954, and in all some 50 of the machines are likely to be built for the R.C.A.F. Only the wing, tail unit, undercarriage and flying controls of the original Britannia have been retained; some 60 per cent of the structure has been redesigned or modified by Canadair. A crew of 15 will be carried and armament will be installed in two weapons bays. Radio and radar installations will number over 20, and to the rear of the glazed observation station in the nose is a bulbous radome and in the extreme tail a magnetic airborne detector—an electronic device which measures the intensity of the earth's magnetic field and reports distortion caused by the presence of a submerged submarine. This installation increases the fuselage length to 122ft. Fuel capacity should suffice for an endurance of some 24 hours.

The first CL-28 is expected to fly this year.

U.S.A.

Lockheed P2V-7 Neptune This most recent and most efficient of the long and varied Neptune maritime-reconnaissance anti-submarine line has two Westinghouse J34-WE-34 under-wing turbojets in addition to its two Wright Turbo-Compound piston engines. Take-off benefits not only from the augmented thrust but from the lighter weight, and the machine is generally more manoeuvrable.

A makers' announcement runs: "Although closely resembling its predecessors, the P2V-7 is different in numerous respects. Major design changes encompass the entire forward fuselage area, where pilot and co-pilot have an enlarged work area, with a double-bubble canopy enabling them to see all four engines, the tail, and the sky and sea around them. Newly designed and faster operating nose landing gear has been built into the P2V-7. Wing-tip tanks have also been redesigned. Rearrangement of certain secret interior components has resulted, with other changes, in a subsequent weight saving under previous Neptune models. This Neptune-7 makes use of the latest simplified multi-function control systems developed by Lockheed. The so-called 'gang' landing gear control, for example, controls also the plane's emergency and parking brakes. If emergency braking is needed on landing, the pilot need not take his hand from the control which lowers the landing gear—but just moves the same knob farther along its track."

Electronic equipment weighs a ton and a half, and conversion is possible for anti-submarine work, patrol, minelaying, torpedo-dropping, or bombing. The long, pointed tail which distinguishes this and other late Neptunes contains a magnetic airborne detector (MAD) and, remarkably enough, this not only increases the Neptune's effectiveness as an anti-submarine weapon but improves its top speed and range through improved streamlining. Possible loads are twelve 325 lb depth charges or sixteen 500 lb bombs.

The latest weapon for which the -7 Neptune has been adapted is the Fairchild Petrel, an air-to-surface missile declared to have "a degree of reliability considered exceptionally high for such a sophisticated weapon." The Petrel is designed primarily for use against ships at sea and is launched well outside the range of anti-aircraft armament. One Petrel is carried under each wing.

Span, 103ft; length, 91ft 5in; empty weight, 43,950 lb; gross weight, 72,000 lb; max. speed, 300 m.p.h.; service ceiling, 22,000ft.

Martin P5M-2 Marlin Successor to the P5M-1, this flying boat has a low bow chine, permitting higher gross take-off weights and lessening the possibility of spray damage to surfaces and airscrews. The high T-shaped tail reduces structure weight and drag, and eliminates spray damage to the tail surfaces, and the long hull afterbody provides improved control during rough-water landings and take-offs. "Hydro-flaps" on both sides of the hull afterbody act as brakes when opened together or as rudders when operated separately. A streamlined pod housing cameras can be attached to the hull exterior for assessment of damage to the enemy following day or night operations. To allow maintenance during extended operations provision is made for hoisting aboard a seaplane tender at a gross weight of 60,000 lb.

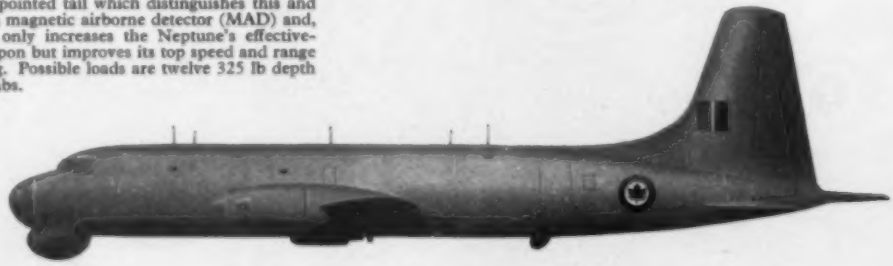
The crew numbers seven and extensive provision is made for anti-submarine operations. The magnetic airborne detector is of the AN/ASQ-8 MAD type, mounted in a tubular plastic fairing extending aft from the junction of the tail surfaces. In the bow radome is an AN/APS-44A radar scanner. Stowage is provided for bombs, mines, depth charges, rocket projectiles or torpedoes. Two Wright R-3350-33W engines are fitted; empty weight is 46,933 lb, gross weight 73,055 lb, fuel capacity 2,815 U.S. gallons, range 2,500 nautical miles, maximum level speed 250 m.p.h., maximum diving speed 302 m.p.h., alighting speed 97 m.p.h.

Span, 118ft; length, 98.9ft.

Martin XP6M-1 SeaMaster The first prototype of this unique high-speed, four-jet, long-range, mine-layer or reconnaissance aircraft was destroyed after it had completed just over 50 hours' flying, and as a result the special military equipment fitted in the second prototype has had to be removed and replaced by experimental equipment for the continuance of flight testing. The programme, however, has not been seriously delayed, and the U.S. Navy expects to use many P6Ms for various types of operation, certain of which may involve refuelling from submarines. Though the prototypes were powered with four Allison J71s with afterburners, production models will have Pratt and Whitney J75s. Claimed to be able to operate in "sea state three" (waves averaging 6ft), the SeaMaster has uncommon structural characteristics which were described in detail in *Flight* of March 30th this year. Features include a watertight rotary mine door on which a variety of weapons or a camera pod can be installed interchangeably while the aircraft is afloat or on its beaching gear. The outboard stabilizing floats are fixed and attached directly to the wing tips, and "hydroflaps" of the characteristic Martin type are fitted on both sides of the hull afterbody. Hinged panels extend the full length and width of the nacelles, permitting engine changes while afloat. The cabin is pressurized to 21,000ft altitude at a true altitude of 50,000ft, though normal cruising height is 40,000ft. Maximum speed is "over 600 m.p.h." (a Mach number of .95 is reported to be attainable), disposable load 30,000 lb, and the crew numbers five (pilot, co-pilot, navigator/mine-layer, radio operator and armament defence operator). The last-named man controls the stern barbette, which houses two 20 mm guns.

FRANCE

Hurel-Dubois H.D.35 This development of the H.D.321 civil transport has similar characteristics and will carry modern anti-submarine armament, including homing torpedoes. There is a retractable radome just aft of the nosewheel, a starboard-wing radar nacelle, a transparent cupola on top of the fuselage, and magnetic airborne detection gear in the tail. Endurance will be 20 hours at 100 m.p.h.



Canadair development of Bristol Britannia for maritime reconnaissance.

Advantages of the

ROLLS-ROYCE

CONWAY

BY-PASS TURBO JET

for long range airliners

★

Lower weight giving increased payload

Lower guaranteed specific fuel consumption

Lower first cost and operating costs

Less noise

★

ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

DUNLOP

increases safety and operational efficiency

For over twenty years Dunlop has been concerned with aircraft de-icing problems. Progress in aircraft design has demanded a new approach and a successful electro-thermal method of de-icing has been developed. It is based on the use of electrical heater circuits sandwiched between layers of rubber.

Heating of the circuits can be continuous or cyclic or a combination of both by means of a controller. Used with an ice detector, operation becomes fully automatic.

DUNLOP *DE-ICING SYSTEMS*

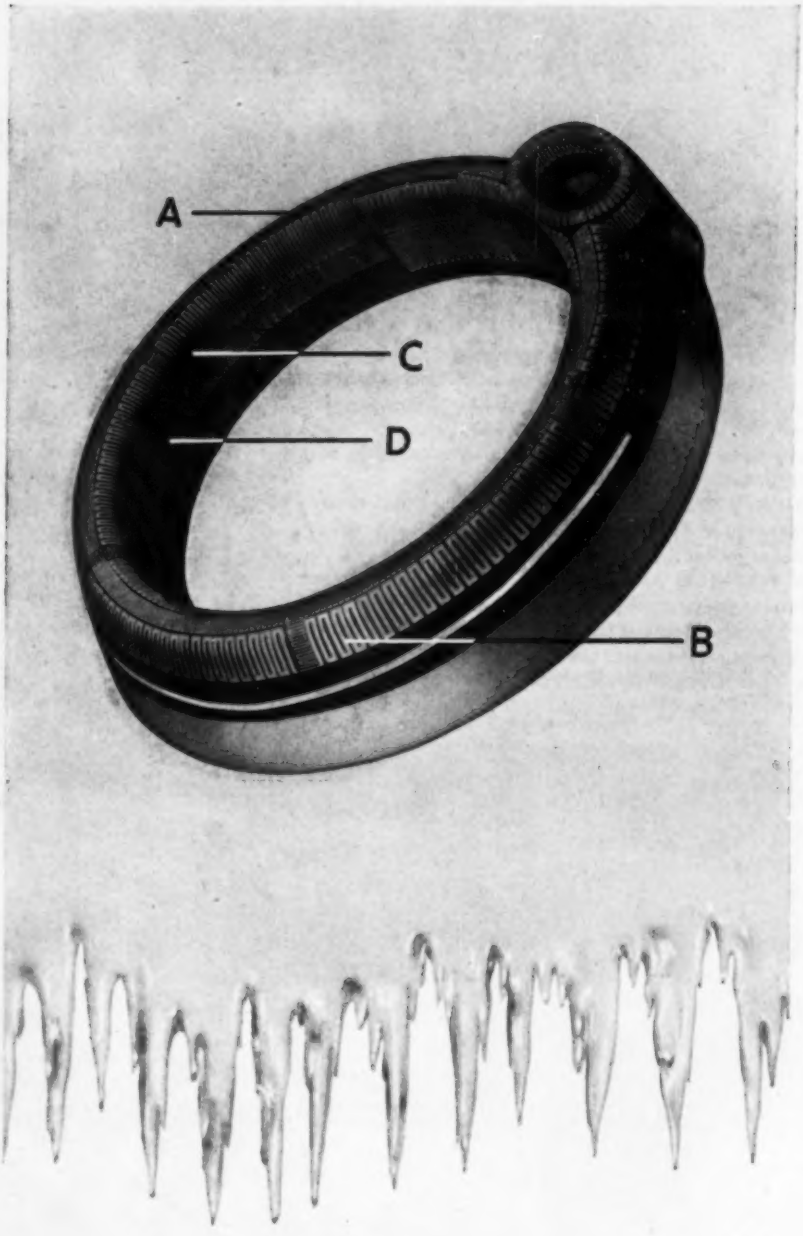
A DE-ICING SYSTEM with 3 important advantages

Dunlop thermal de-icing systems offer the following advantages:—

1. Effective removal of ice without disturbance of airflow.
2. Heat can be varied to give greatest protection at most vulnerable points.
3. Each circuit is "tailored" to suit its particular working conditions.

A further advantage is the ease with which circuits can be repaired if damaged.

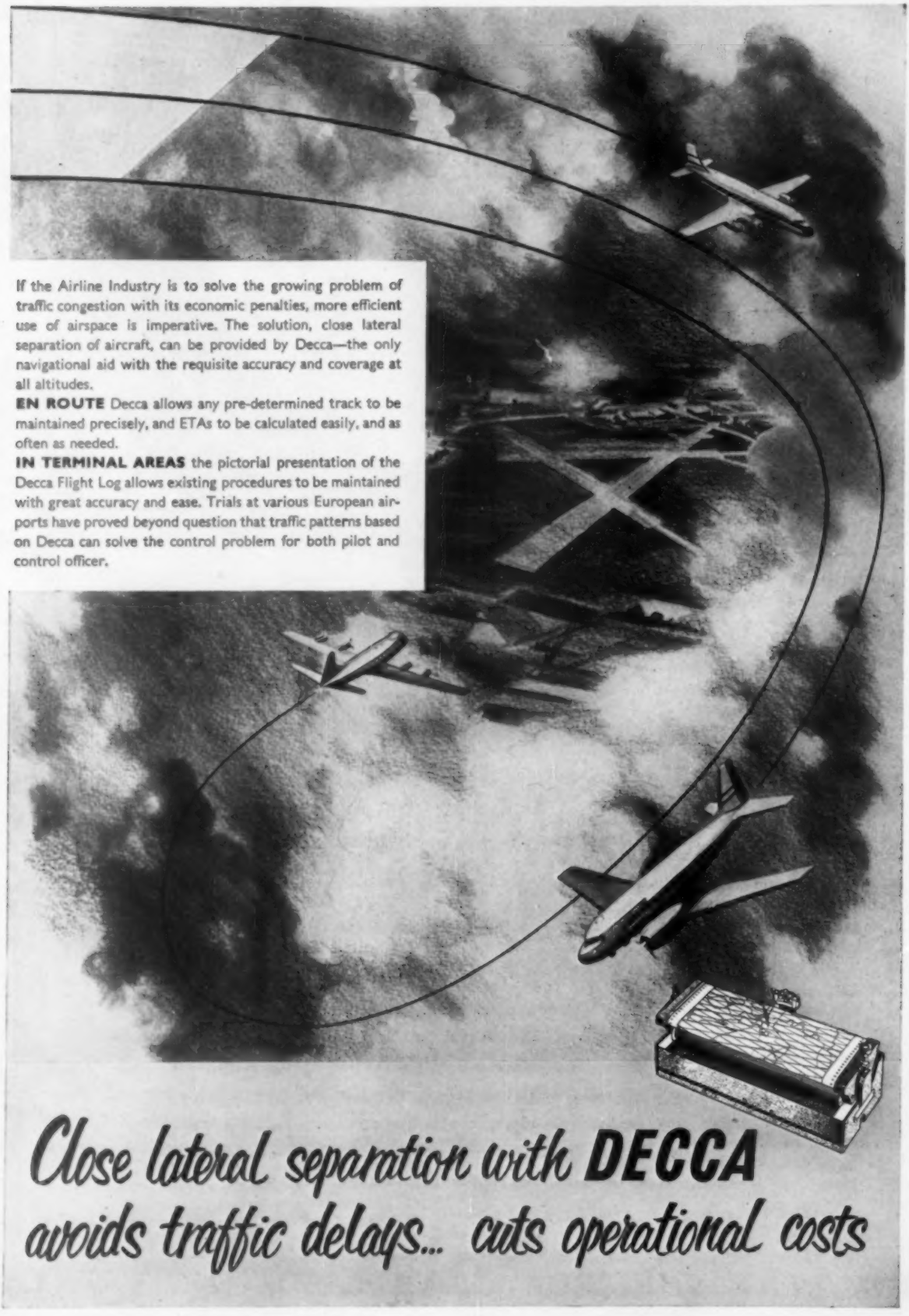
The system consists of a lower layer of unvulcanised rubber which is applied directly to the metal surface of the aircraft. The heater circuit, cut or etched from nickel strip is then placed in position and covered by a second layer of rubber. The rubber is then vulcanised to give a surface resistant to climatic conditions and the effects of fuels and hydraulic fluids.



* A typical application of a Dunlop thermal de-icing mat to the intake duct of a Rolls-Royce 'Dart' engine. Circuit A applies continuous heat of highest intensity to the leading edge of intake.
Circuits B and C are cyclic in operation and apply a lesser degree of heat to areas adjacent to the leading edge.
Circuit D again cyclically operated is situated further downstream of the intake and applies the lowest heat intensity.

MEET THE NEEDS OF THE AVIATION INDUSTRY

GH/604

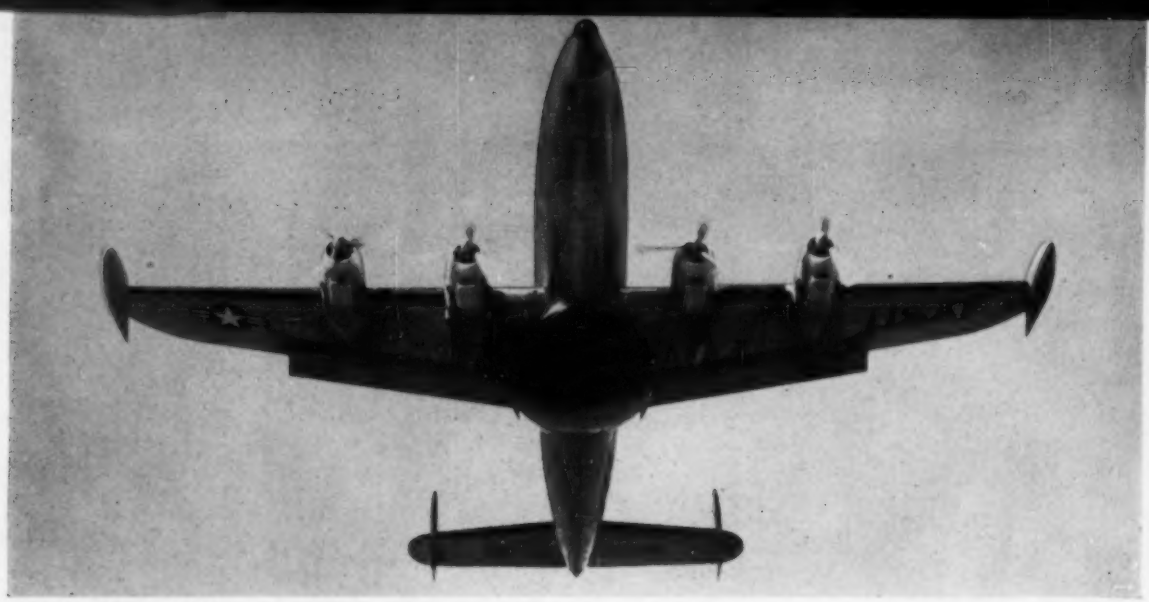


If the Airline Industry is to solve the growing problem of traffic congestion with its economic penalties, more efficient use of airspace is imperative. The solution, close lateral separation of aircraft, can be provided by Decca—the only navigational aid with the requisite accuracy and coverage at all altitudes.

EN ROUTE Decca allows any pre-determined track to be maintained precisely, and ETAs to be calculated easily, and as often as needed.

IN TERMINAL AREAS the pictorial presentation of the Decca Flight Log allows existing procedures to be maintained with great accuracy and ease. Trials at various European airports have proved beyond question that traffic patterns based on Decca can solve the control problem for both pilot and control officer.

Close lateral separation with **DECCA**
avoids traffic delays... cuts operational costs



Lockheed RC-121D.

MILITARY AIRCRAFT 1956

RADAR PICKET

THE early-warning radar picket aircraft is an American development of recent years, and most, if not all, of the large machines in this category have been built by Lockheed (for the U.S.A.F. and U.S. Navy). A spokesman of this company has rightly claimed that these are "the next best thing to a 'phone call from the enemy"; he remarked that they could provide as much as three to five hours' warning of an enemy attack on the U.S.A.

Smaller carrier-borne machines perform a like service for the fleet, and are typified by special versions of the Douglas Skyraider. One of these will eventually be replaced in the Royal Navy by a development of the Fairey Gannet anti-submarine aircraft.

U.S.A.

Douglas AD-5W Illustrated on this page is the early-warning version of the "Multiplex" Douglas AD-5 Skyraider. This type continues in service with carrier-borne units of the U.S. Navy.

Lockheed WV-2 A development of the Super Constellation for the U.S. Navy, the WV-2 is powered with four Wright Turbo-Compound engines. It has an endurance of over 24 hours (by virtue of large internal and wing-tip fuel capacity); carries more than six tons of electronic equipment; has a crew of 26, and numbers among its amenities bunks convertible to couches, a galley with refrigerator, running water and grills. It is classed as a radar picket and countermeasures aircraft. For picket duties it carries very powerful search radar to high altitudes, where this equipment attains its maximum effectiveness; and even should the enemy approach under the beam of normal radar the WV-2 could pick him up far beyond normal protection zones. By the use of U.H.F. radio details of enemy strength, direction, height and speed can be transmitted to defending intercepters.

The most distinctive features of the aircraft are the great fungus-like growth above and below the fuselage. The upper protuberance is 8ft tall and houses the height-finding radar antenna, whereas the "guppy" bulge below carries equipment to determine the speed, strength and direction of air or sea threat.

The cabin of the 113ft-long fuselage is pressurized to maintain 10,600ft altitude at 25,000ft; it is liberally soundproofed, and the seats are scientifically designed to minimize fatigue on long patrols. Each WV-2 carries a complete electronics maintenance shop and a team of specialists to make in-flight adjustments and repairs. A special point is made of keeping the crew well fed and refreshed, and two crews are carried for all stations so that rested men are instantly available in an emergency-search situation.

The operational nerve centre is the "combat command centre," where radar watchers provided by the Combat Intelligence Organization do their spotting, plotting and directing. To the rear are five radar search scopes, and, at the extreme after end of the cabin, bunks.

Photographs show, for example, intercom switches for crew-members designated CICO, ACICO 1, ACO 2, 3, 4 and 5, height finder, radar operator, ECM operator, poster, talker and plotter.

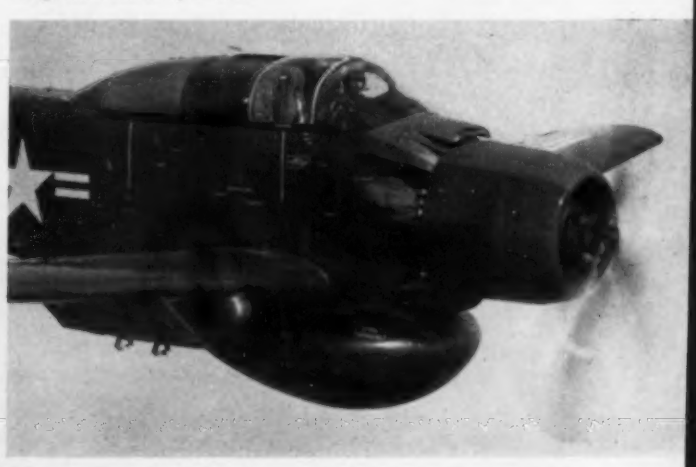
Lockheed WV-3 This new development of the WV-2 carries meteorological equipment in addition to its electronic gear, and is thus suitable for use as a "hurricane hunter" as well as a long-range radar picket. Built in is a pressure chamber for releasing balloons.

Lockheed RC-121D The RC-121 is the U.S.A.F. counterpart of the Navy's WV-2, and the "D" variant, introduced late in 1954, is distinguished from earlier models in having 600 U.S. gallon wing-tip tanks and a 1,000 U.S. gallon fuselage tank to extend endurance. Total fuel capacity is 8,750 U.S. gallons. Interior changes include new radar consoles with larger viewing scopes. A point of interest is the special cooling system to relieve the heat generated by approximately 3,000 vacuum tubes used in the radar and other electronics facilities.

Of the family of Lockheed radar pickets generally the company's chief engineer has said that the addition of the vast radar protuberances has little effect on handling or performance, apart from decreasing speed by a few per cent. He added that the triple-fin tail was particularly well adapted to the job because the outboard vertical surfaces were not affected in any way by flow disturbances round the fuselage.

Dorsal and ventral radomes of Lockheed RC-121D.

Douglas AD-5W early-warner.



Westland Wyvern S.4.

MILITARY AIRCRAFT 1956

CARRIER-BORNE STRIKE

THE aircraft dealt with under this heading have been specifically designed for carrier-borne attack operations (against maritime and/or land targets) and no account is taken of the numerous types of naval fighter adaptable for strike operations, though allusion was made to certain of these under "Ground Attack."

Though a new type of pure-jet, carrier-borne strike machine is known to be under development for the Royal Navy as a successor to the turboprop Westland Wyvern, the pre-eminent examples now in being are the Douglas Skywarrior and Skyhawk, respectively representing the heavy and light categories. The Skywarrior is notable for its ability to combine long range atomic performance with the execution of low-level strike or mining missions.

GREAT BRITAIN

Westland Wyvern S.4 Development of the U.S. Navy's Douglas Skyshark having been abandoned, the Wyvern remains as the only turboprop strike aircraft in service. The engine is an Armstrong Siddeley Python of 3,650 e.h.p. driving a contra-rotating Rotol airscrew, and gross weight is believed to be well over 20,000 lb. Four wing-mounted 20 mm guns are supplemented by under-wing bombs, rockets, depth charges or mines, and a typical load is a 2,000 lb bomb or sixteen 60 lb R.P.s. Features include hydraulically operated Youngman lift flaps, air-brake flaps on the inner wings, and a wide-track, long-stroke undercarriage. Wyvern squadrons based in the United Kingdom are practised in artillery spotting and tactical reconnaissance.

Span, 44ft; length, 41ft 10in.

U.S.A.

Douglas A3D-1 Skywarrior The Skywarrior is the world's heaviest, most powerful, and (at two million dollars) most costly naval strike aircraft, and was designed to operate from the Forrestal class of carriers. Its official U.S. Navy classification is "heavy attack." A three-seater (pilot, bomb-aimer and gunner/navigator), it is powered by two Pratt and Whitney J57 two-spool turbojets of some 10,000 lb thrust each, and weighs about 70,000 lb all-up. Level speed is well over 600 m.p.h. (it is reported that Mach 1 has been exceeded in a dive) and service ceiling 41,000ft. With JATO, full-load take-off is possible from a U.S. Navy carrier without catapult assistance. Initial deck-landing trials have lately been conducted, as shown by the photograph reproduced at the foot of this page.

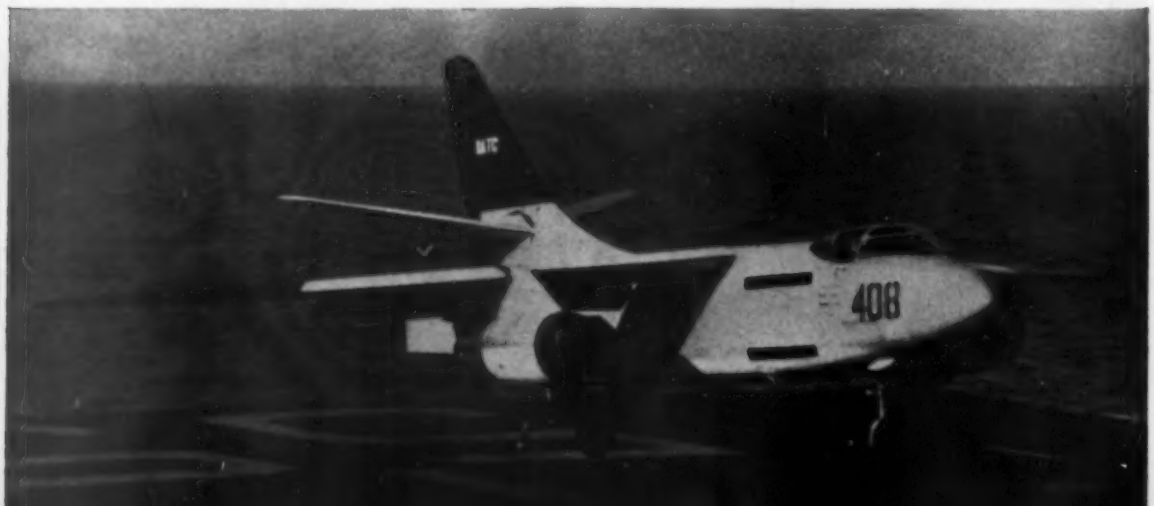
As in other Douglas naval aircraft, particular attention has been paid to weight reduction. For example, there is a simplified belly-type escape 'chute whereby each crew-man slides, in emergency, feet first through a trap door, which also acts as a wind break. Use of this method of escape is said to save 550 lb. (For every pound saved on equipment during the preliminary design stage, incidentally, Douglas were able to eliminate an average of 9 lb in wing and tail areas, powerplant, undercarriage, etc., while retaining performance at a constant level.

Many aspects of the Skywarrior's design were the subject of a special study in *Flight* of February 18, 1955, from which these are extracts: "The necessity for rapid deceleration in the air is a fairly obvious requirement for all attack aircraft, and the A3D was provided with a pair of huge speed brakes, one on either side of the rear fuselage. Each takes the form of an unperforated panel hinged at its forward edge and opened against the airstream by a hydraulic jack. As the A3D is not intended to be flown in formation it was found unnecessary to provide for partial brake operation; accordingly, the panels can be selected 'on' or 'off' by a switch. As both brakes are either shut, fully open, or moving together, it was not necessary to provide any 'cross-ship' connection.

"The fuel system of the A3D was made unusually simple for an aircraft of such a size. Fuselage fuel is carried in two tanks already mentioned, which are of the self-sealing type. In addition, the whole wing forms an integral tank between the spars from the side of the fuselage to the wing fold . . .

"The weapons bay is worthy of note. A few large stores—presumably nuclear—are carried by a single shackle under the centre wing, but the majority of the stores carried by the Skywarrior are attached to a removable platform located approximately half-way up the weapons bay (this platform can also carry an additional self-sealing fuel tank connected to the aircraft fuel system). The bombs supported from the

Douglas A3D-1 Skywarrior.



Douglas A4D-1 Skyhawk.

platform are carried on individual ejector racks, 18 racks being employed to ensure positive separation of low-density stores. An anti-buffet rake is also fitted ahead of the bay; this is opened by a jack tied to the bomb-door circuit and has been found to reduce buffet to an acceptable level under all conditions."

For rear defence there are two remotely controlled 20 mm guns in a tail barbette with the fire control radar installed above it. Range is 2,000 nautical miles. Reference has been made to an A3D-2P for photographic reconnaissance and an A3D-2Q for radar countermeasures. A transport version is also said to have been planned.

Span, 73ft; length, 74ft 6in.

Douglas A4D-1 Skyhawk In more than one respect the Skyhawk is one of the most significant military aircraft of post-war years. Though capable of carrying an atomic bomb or heavy loads of conventional weapons (bombs, rockets, guns or missiles), its span is a mere 27ft (rendering wing folding unnecessary), and gross weight not greatly in excess of 20,000 lb. Range is said to be sufficient for non-stop crossings of the U.S.A. and is, in any case, claimed to be "greater than present propeller-driven attack aeroplanes." Lightness and simplicity were keynotes, and Douglas's chief engineer (El Segundo) has said: "The A4D is believed to be a major step in designing an airplane on a completely functional basis, making each requirement stand on its own feet rather than by doing things because they had been done that way in the past. The 'mighty midjet' was conceived as a single, integrated weapon designed to fit the pilot and his needs. Under our programme of design simplification the A4D gained 20 per cent more in speed and a third more in range than was at first thought possible."

Typical examples of weight-saving are the air-conditioning system (one-third the weight of the system previously used), and the ejection seat (a half the weight of that used in the A4D's predecessor). Some 172 lb of electronic equipment were "repackaged" into a compact aluminium container weighing only 136 lb and a special lightweight bomb-sight was evolved.

The delta wing is of extremely simple construction, and houses internal fuel tanks and has leading edge slats. The fuselage also houses much fuel (the total internal load is thought to be well in excess of 600 gallons), and carries lateral intakes for the Wright J65 (Armstrong Siddeley Sapphire licence) turbojet. Two 20 mm guns are built into the wing roots, but all major armament loads are carried externally.

Indicative of performance is the record speed of 695.162 m.p.h. over a 500 km closed-circuit course. Previous records of this class were held by fighters and certainly not by carrier-borne attack machines.

Douglas AD-5 Skyraider The so-called "Multiplex" version of the Skyraider, this is already well known for its amenability to conversion for any one of twelve rôles, utilizing "packaged" conversion kits. Equipment can be provided for attack by day or night, early warning, anti-submarine search and strike, photographic reconnaissance, target-towing, ambulance work and transport. As a strike aircraft it carries two 20 mm guns in addition to two 11.75in Tiny Tim rockets, two 2,000 lb bombs, two 2,150 lb torpedoes, or varied loads of mines, depth charges, smoke containers or searchlights. Twelve wing pylons carry either twelve 5in rocket projectiles or the same number of 250 lb bombs.

Douglas AD-6 and -7 These models are specialized single-seat attack machines and are the latest of the Skyraider series, of which some 3,000 were built between 1946 and April 1956. Deliveries of the -7 will begin in August this year. This model differs from the AD-6 in having a Wright R-3350-26-WB engine and strengthened wing "to prolong service life under higher tactical loads." The makers point out that whereas the Skyraider was originally designed to carry a 1,000 lb bomb load, late versions have taken off with combinations of bombs to a weight of over 10,000 lb.

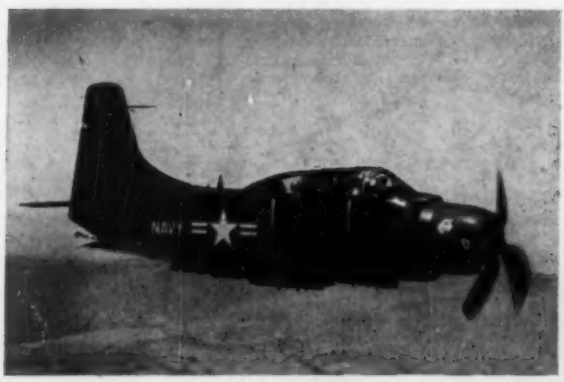
North American AJ-2 Savage Pending the introduction of the Douglas Skywarrior, the AJ-2 Savage remains as the standard heavy-attack aircraft of the U.S. Navy. It is powered with two Pratt and Whitney R-2800 piston engines and an Allison J33 turbojet, all burning the same type of fuel. Maximum speed is 425 m.p.h. and service ceiling over 40,000ft. An atomic bomb is a possible load and conventional weapons up to about 10,000 lb in weight can be stowed. Gross weight is 37,000 lb and tactical radius some 500 miles.

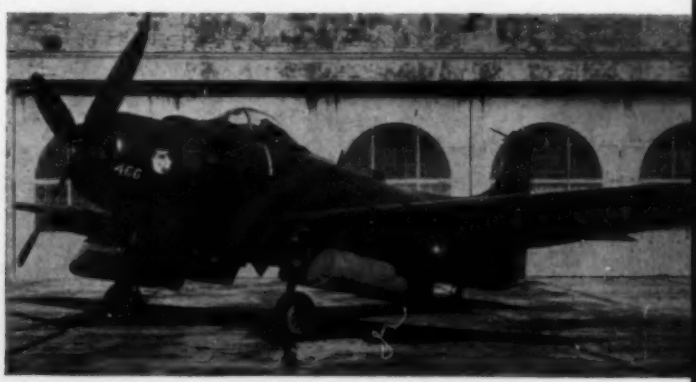
This extract from a report on a Savage-equipped squadron is reproduced from *Naval Aviation News*: "The pilot, who is the plane commander, sits in the left seat where he drives the plane with a 'yoke' and controls the three engines with throttles mounted on a centre console. Old carrier pilots who thought that no plane would ever go aboard ship with anything but a stick and left-hand throttles are universally amazed at the ease with which they adapt themselves to the unique AJ cockpit arrangement. The bombardier-navigator, or 'three-headed monster' as he is referred to in heavy attack circles, could easily utilize three heads and four arms in the performance of his many in-flight duties. Occupying the right seat, he must operate a radar set, a bombing system, several radios, and perform radar, celestial and dead reckoning navigation."

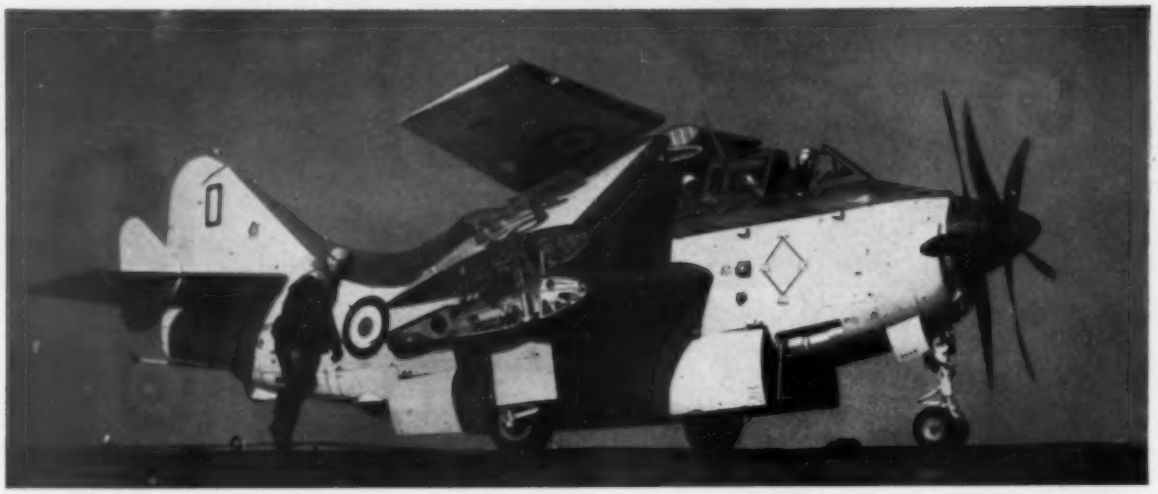
A number of Savages have been converted for use as tankers, and, as already remarked, the type is also used for photographic reconnaissance (AJ-2P).

Span, 75ft; length, 65ft.

(Above) Douglas AD-6 Skyraider. (Below) AD-5 Skyraider. (Lower right) AD-6 Skyraider, apparently carrying mines and radar.







Fairey Gannet A.S.1.

MILITARY AIRCRAFT 1956

Ship-Borne ANTI-SUBMARINE

THOUGH in Great Britain, the U.S.A. and France, fixed-wing, carrier-borne, anti-submarine aircraft continue in production and under development, the helicopter is steadily encroaching on the fixed-wing preserve. Ambitious designs are in hand. Doman, of America, for instance, are said to have submitted to the U.S. Navy designs for a machine weighing some 17,000 lb, powered with three General Electric T58 gas turbines, housing special anti-submarine weapons in retractable launchers and having a hinged tail folding upwards over the fuselage. The four main rotor blades will also fold.

Pending the introduction of such aircraft as this, modern specialized designs, exemplified by the Sikorsky HSS-1, are in production.

Anti-submarine helicopter techniques and weapons are for the greater part secret, but some interesting disclosures were authorized by the American Navy in an article in one of their official publications last year. "Certainly the rotary-winged warrior is far from letter-perfect in the new rôle," it was stated, "but it is probably safe to say that it is a rising and dramatic star." The article continued: "Recent successes . . . have confirmed the importance of the helicopter in anti-submarine warfare. . . It can hover motionless over the water and move quickly from one point to another. Add to the helicopter sub-surface detection equipment, namely dipping sonar, and it is ready for action.

"A comparison of the helicopter and the destroyer—both now carry similar items of detection gear—points to certain advantages of the helicopter. The dipped sonar transducer lies motionless in the water and is therefore not subject to the disturbing effect produced by the rush of water past the sonar transducer of a destroyer moving rapidly through the water. Its detection potential is therefore considerably enhanced.

"The dipped sonar can be transported at will and at many times the speed of the destroyer sonar over large areas. Finally, and perhaps most important of all, the helicopter is now invulnerable to sub-surface attack and need not exercise caution in its approach to a known contact area.

"There are other advantages which the sonar-equipped helicopter possesses over surface-borne sonar and, needless to say, there are some deficiencies. However, these three outstanding advantages are most important, and it is on them that present operational employment of helicopters in anti-submarine tactics is based.

"This is not to say that the helicopter can replace the destroyer in present day anti-submarine operations. Combining the two has proved highly successful. Capitalizing upon the three basic superior capabilities of the helicopter and adding to them the staying power of the destroyer, a sizable stinger has been developed for our anti-submarine forces and the probability of obtaining a kill on the modern submarine is increased."

In a screening mission, it is remarked, helicopters are vectored to their respective hover positions. If there are enough of them, they may constitute an independent helicopter screen; if there are only a few, they can be used as an adjunct of the destroyer screen. Vectoring the helicopters into the screen, as well as subsequent control of them during their series of dipping cycles, is done either by surface vessels or by the helicopter pilots navigating themselves. After they are in position, the helicopters conduct a running series of hovers. As they complete a sonar dip at each point, they advance along a base course to the next hover. The distance between hovers is based upon the range capability of the sonar for existing conditions.

The time in hover is predicted upon the speed of advance of the screened unit as well as existing sea conditions. In the screen missions, the helicopters remain on station until relieved. If a contact is made on a submarine attempting to penetrate for an attack, the helicopter with the contact holds on to it. The hole in the screen will be plugged by a sonar-equipped helicopter from the carrier.

"Back on the carrier," the U.S. Navy account continues, "there are one or more 'copters armed with homing weapons. They are kept in Condition One. Upon receipt of contact, the killer helicopters are instantly launched and vectored to the area. They are then guided by the helicopter with contact into the attack position. (If the attack helicopter can carry sonar and weapons, it could, if necessary, vector itself into position.)"

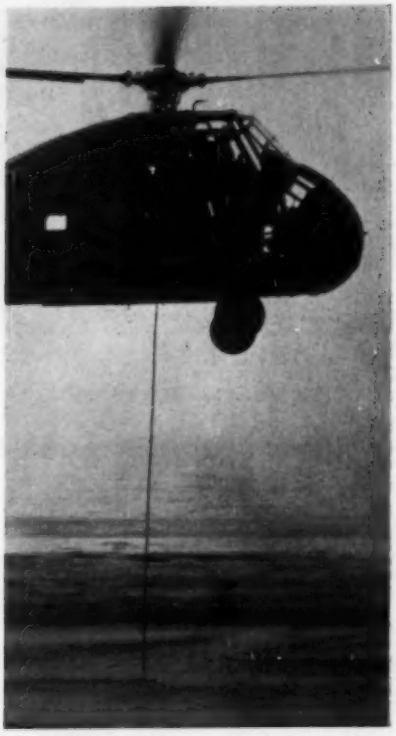
The second mission of the anti-submarine helicopter—that of hunter/killer—is described in these terms: "In most instances a fixed-wing aircraft or a blimp will establish initial contact at some point fairly remote from the task group or convoy. For example, a P2V makes radar contact followed by an attack on a

Short Seamew A.S.1.

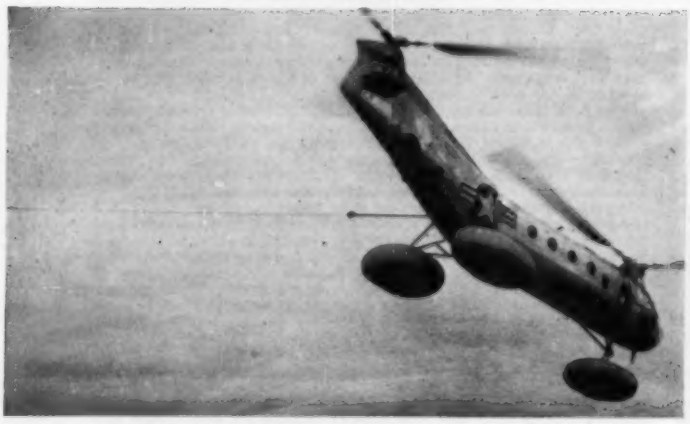
Grumman AF-2S with sonobuoy dispensers, depth charges, R.P.s and searchlight.

For Under-Water Warfare

Extended radome and MAD boom of Grumman S2F-1.

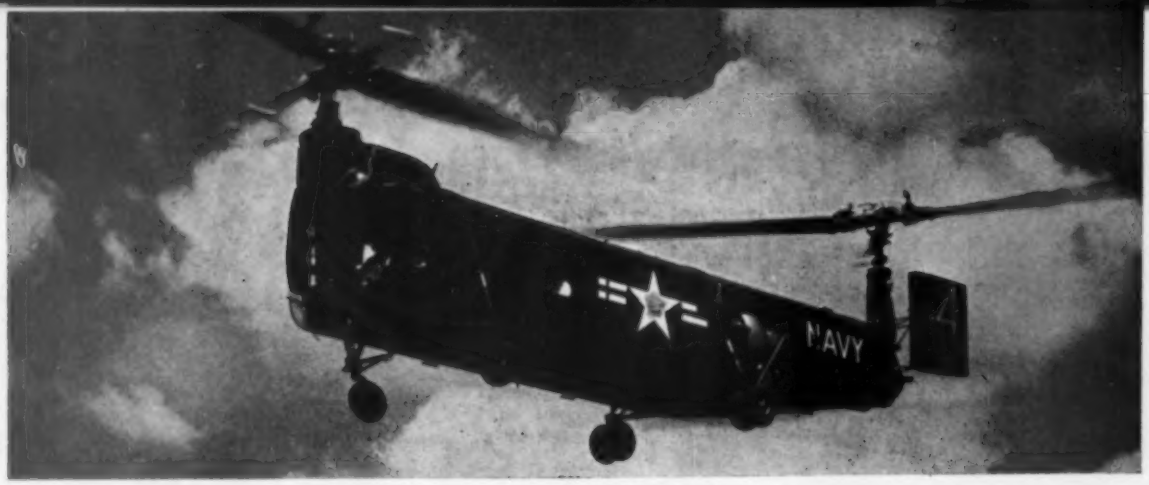


Sikorsky HSS-1 with sonar gear lowered.



Vertol H-21 towing minesweeping gear.
Forepart of Short Seamew A.S.1, showing radome.

Search radar of Martin P5M-1 Marlin.
Sonobuoy stowage in nacelle of Grumman S2F-1.



Bell HSL-1.

MILITARY AIRCRAFT 1956

Ship-Borne Anti-Submarine

submarine. It works over the point and establishes a datum. Upon receipt of contact information aboard the carrier, two or more H/K helicopters are launched; at least two with sonar equipment and one with weapons. On arrival at the datum, sonar search is conducted. The probability of gaining contact is high. Then with the contact sure, the helicopter uses the anti-submarine weapons it carries. And another submarine discovers the sentinel is fully and most destructively armed."

It is appropriate here to mention the possibilities of the helicopter as a minesweeper and general-purpose naval "tug." In 1953 the Piasecki (now Vertol) H-21 tandem-rotor helicopter proved its ability to tow standard naval minesweeping gear at speeds above those attainable by naval minesweepers, flying, of course, in a marked nose-down attitude. Its manœuvrability for sweeping in restricted areas was also demonstrated. In "armament towing attitude tests" a Bell HSL-1 helicopter has been flown at a nose-down angle of no less than 45 deg.

GREAT BRITAIN

Fairey Gannet A.S.1 A glimpse of the Gannet's equipment and armament was afforded at the 1955 S.B.A.C. Display. Grouped round a parked machine was a most impressive assortment of stores, ranging from rockets and practice bombs, through large air/sea-rescue containers to 500 lb, 1,000 lb and 2,000 lb mines. Sonobuoys were included and there were flame-, smoke- and noise-producing floats, but no specific anti-submarine weapons other than special bombs. It is known, however, that the Gannet can carry the most up-to-date "A.S." weapons including homing torpedoes.

The Gannet A.S.1 is now thoroughly worked up in service with the Royal Navy and the Royal Australian Navy, and its essential features have long been familiar. Key to the design is the Armstrong Siddeley Double Mamba twin-turboprop which has a low noise-level and needs no cumbersome flame dampers. The ability of the Gannet to fly on either half of the engine is claimed by the makers to confer these advantages: (1) the factor of double safety is introduced, since the aircraft is in effect twin-engined; (2) maintenance is reduced, since for most of its flying life only one half of the engine is in use, and this brings advantages concerning the overall wear and tear in the life of the engine (3) whilst sufficient power for cruising is available from one half of the engine, full power of the double engine ensures an excellent take-off and a reserve of power for emergency use (for example, on going in to attack or on a baulked approach to deck landing).

The Fairey company look forward to the benefits which will be conferred by new developments of the Double Mamba. They expect that even with considerably increased weapons-loads, performance will at least be maintained, and improvement in consumption would make the extra loading acceptable without sacrifice of range or endurance. In this connection this comment from *Flight's* "Aero Engines of the World" special number (May 11, 1956) is worth noting: "In view of the performance of the later Mambas, it appears that it should not be impossible to have a 4,000 h.p. Double Mamba in service before very long." (The Mamba at present used in the Gannet is thought to deliver about 2,950 h.p.)

Span, 54ft 4in; length, 43ft.

Short Seamew A.S.1 and M.R.1 The Seamew is being built in two forms—the A.S.1 for the Fleet Air Arm of the Royal Navy, and the M.R.2 for R.A.F. Coastal Command. It is one of the few modern military aircraft for which full loading and performance data are available, and it was the subject of a very full description in *Flight* of January 20, 1956. On that occasion its designer recalled that it was in 1951 that the Naval Staff, from considerations of the anti-submarine warfare of the late war, concluded that there was a need for a simple, yet fully effective, light aircraft for anti-submarine duties. The design target was a four-hour patrol at 120 kt, and this was achieved. Take-off performance in a 12 kt wind is 500ft and even in still air it is only 300 yd. The total stores load is in excess of 1,800 lb, with some stores carried on the wings and some internally, and several combinations are possible, including mines, sonobuoys and torpedoes. The normal level speed of the aircraft is about 200 kt, but it is cleared to the relatively high diving speed of 325 kt; this is to enable attacks to be made from altitude by diving on the enemy. The speed range between stalling speed and diving speed is unusually large for an aircraft of this type. The forward position of the radar scanner ensures that, even in a steep dive, the target is always in the radar view and never blanked by the nose of the aircraft.

The ASV radar is fully incorporated, with a rotating scanner housed within a prominent radome under the forward fuselage. With the exception of the indicator and the control unit, the whole of the gear is accommodated in a hinged bay for easy access. Other equipment includes VHF radio telephone, H.F./T.R. voice equipment, inter-communication equipment, low-level radio altimeter and a pilot-interpreted short-range navigational aid.

Alternative weapons loads of the Seamew A.S.1, in its present form, are: four 275 lb anti-submarine bombs; two 275 lb A/S. bombs, four R.P.s and eight 28 lb sonobuoys; or 20 sonobuoys and six R.P.s. With an enlarged (17ft) weapons bay and fuel for a three-hour patrol, it is possible to carry six 275 lb A/S. bombs and three R.P.s, or one 2,000 lb "weapon" (this may be assumed to be a form of homing torpedo); or 28 sonobuoys and six R.P.s. No gun armament is carried for anti-submarine duties.

Span, 55ft; length, 41ft; typical take-off weight (A.S.1), 13,884 lb; performance (A.S.1): starting at 14,000 lb take off in 747ft (still air) or 495ft (into 12-kt wind) at 60.7 kt t.a.s.; initial rate of climb, 1,600ft/min; level speeds, 211 kt at sea level or 198 kt at 10,000ft (emergency rating) and 196 kt at sea level (max. cont. power); patrol at 120 kt at 5,000ft, fuel used will be 59 lb for starting and take-off, 64 lb for climb, 2,310 lb for four hours' patrol, 28 lb for descent, and 50 lb for landing, allowing five minutes at 100 kt with 20 deg flap (total 2,511 lb or 326 Imp. gal of wide-cut); landing at 12,900 lb, approach at 15 deg at 65-70 kt and take 1,600ft over 50ft screen (no wind).

Grumman S2F-2.

Among the many advantages of the Avro Vulcan is its outstanding performance at High Altitude. Major factors are its low wing-loading, clean lines and exceptional manœuvrability. Yet another powerful reason why the Avro Vulcan, soon to enter service with the Royal Air Force, is the world's most formidable bomber.

THE WORLD'S MOST EFFECTIVE BOMBER—AVRO VULCAN

Aerodynamic Simplicity
Easy Landing
Exceptional Safety
Great Range
HIGH ALTITUDE FLIGHT
High Speed Flight
Servicing Simplicity
Fighter-like Manœuvrability
Large Carrying Capacity
Great Development Potential

A. V. ROE & CO. LIMITED · MANCHESTER · ENGLAND
Member of the Hawker Siddeley Group
Pioneer . . . and World Leader in Aviation

K

Long Range Ground Attack

As an air weapon for Long Range Ground Attack, the Hawker Hunter is unequalled in the West today. High speed and extreme manoeuvrability combine to fit it admirably for low level close support duties; whilst two extra fuel tanks and two banks of rocket projectiles give it increased range and tremendous attacking fire power. In addition, the Hunter is the only fighter in service with four 30 m/m cannon as basic armament. To add to its operational versatility, the Hunter can also carry bombs and guided missiles — all this requiring no more than one pilot and one maintenance crew. No wonder it was chosen for NATO defence — backed by large orders from the Governments of Britain, Sweden, Denmark, Holland, Belgium and Peru.

GIVE GENEROUSLY
R.A.F. BENEVOLENT FUND
AT PORTLAND PLACE
LONDON, W.1.

HAWKER AIRCRAFT LIMITED, KINGSTON-ON-THAMES AND BLACKPOOL, ENGLAND

MEMBER OF THE HAWKER SIDDELEY GROUP | PIONEER...AND WORLD LEADER IN AVIATION

Sikorsky HSS-1.

Grumman S2F-1

MILITARY AIRCRAFT 1956

Ship-Borne Anti-Submarine

Westland-built S-58 In March this year the Parliamentary Secretary to the Admiralty, dealing with helicopters and their employment in connection with under-water warfare, said that ideas and information were being exchanged with the Americans, who shared our confidence in the great possibilities of this method of anti-submarine defence. He added that the possibility of using helicopters for mine-sweeping was being investigated, and said that plans were on foot to use the Westland S-58 single-rotor helicopter. The Parliamentary Secretary also referred to the efficiency of helicopters "in operating an Asdic set free from ship noises and practically free from effective retaliation by a submarine."

The British S-58 (U.S. Navy HSS) will have a Napier Gazelle gas turbine.

U.S.A.

Bell HSL-1 Of interest in having been designed specifically for anti-submarine warfare, the HSL-1 is understood to have encountered a number of operation problems, particularly associated with lifting power, and rotor blades of larger diameter are apparently being fitted. An order on behalf of the Royal Navy was cancelled many months ago.

The Pratt and Whitney R-2800 piston engine (1,900 h.p.) is installed aft on a hinged mounting and the twin rotors are arranged to fold for carrier stowage. In the original design provision was made for anti-submarine equipment and armament totalling some 4,000 lb in weight and including dipping, sonar and "lightweight homing weapons." Thus the HSL-1 is both a hunter and a killer.

A special Bell-developed automatic pilot relieves the pilot of tedious and constant manual control during the use of sonar equipment. By eliminating the margin of human error it also permits greater precision of control. Two pilots and two sonar operators are carried.

Grumman S2F-1 The U.S. Navy's counterpart of the Fairey Gannet (though differing remarkably in technical make-up), the S2F-1 was designed to combine the dual functions—hunter and killer—of the two versions of its single-engined predecessor, the AF-2 Guardian. Itself twin-engined (two Wright R-1820-76 Cyclone piston engines) it is of conventional layout and carries a crew of four (pilot, co-pilot, radio operator and radar operator). Equipment and armament includes detection, radar (in a retractable "dustbin"), the magnetic airborne detector, homing torpedoes, depth charges or rocket projectiles. Sonobuoys are stowed in the tails of the engine nacelles, and a searchlight is mounted under the starboard wing. Navigational equipment is lavish, to permit operation under severe weather conditions, and single-engine performance is claimed to be exceptional. The S2F can operate from the decks of the smallest carriers in service with the U.S. Navy.

The following is an extract from a report on S2F operations from an official U.S. Navy publication: "Because of the highly technical nature of anti-submarine warfare, the four S2F crew members must be well trained, experienced men. Before a pilot can be qualified as first pilot of an S2F, he must have almost three years flight experience, including a full year of theory and practice in the S2F. Added to the required knowledge of ASW tactics and all-weather techniques, the pilot must make 48 day and 32 night FCLs before taking an S2F aboard ship. After that are 28 carrier landings, including the eight night landings.

"Only slightly less advanced in his training, the busy co-pilot serves as navigator and radioman, and he operates the powerful searchlights with the pistol-grip type controls installed immediately to his right.

"Directly aft of the compact cockpit, the radarman and Magnetic Airborne Detection Operator (MADman) are engaged in the operating of their intricate equipment, centring around the retractable radar dome and the "Barber pole," the MAD gear. The radarman also evaluates signals from the Sonabuoy [sic] listening devices, which are ejected from a special housing aft of each engine. The MADman's job is also a listening operation. Additionally, these two men are qualified to handle the ordnance aboard the plane."

A version known as the CS2F is being built by de Havilland Aircraft of Canada, Ltd., for the Royal Canadian Navy, and the first of these machines should be coming through in the autumn.

Grumman S2F-2 This developed S2F is designed to carry a newer, larger, "classified" type of anti-submarine weapon, and in order to accommodate this an enlarged torpedo bay has been built into the port side of the fuselage. To compensate for the increase and redistribution of weight tail surface areas have been augmented.

The S2F-2 is already in production, as is the TF-1—a passenger/cargo/trainer/utility version.

Sikorsky HSS-1 In the years immediately ahead the HSS-1 is likely to be the principal anti-submarine helicopter of the U.S. Navy and, as already intimated, a version has been adopted by the Royal Navy. In some ways resembling an enlarged S-55, it is, in fact, notably more efficient, and although the anti-submarine loads may not be specified, the civil version carries twelve passengers or a net payload of 4,000 lb plus a crew of two for a distance of 100 miles. Its normal range is 270 miles and, equipped with auxiliary fuel, it has a ferry range of over 970 miles. Maximum speed is 132 m.p.h. and cruising speed 104 m.p.h. Empty weight (equipped) is 7,530 lb and gross weight 12,600 lb. The engine is a Wright Cyclone R-1820.

FRANCE

Bréguet 1050 Fifty of these carrier-borne anti-submarine aircraft have been ordered and five are expected to be delivered by the end of the year. The crew of three are staggered, the man to starboard and the rearmost occupant having radar scanners. The main wheels retract into "pinion" nacelles, which also house anti-submarine gear, and there is a large radome under the fuselage. Far aft is a ventral air brake. The engine can be an Armstrong Siddeley Mamba 6 or Rolls-Royce Dart 7, and endurance 4 hours.

Blackburn Beverley C.1.

TRANSPORTS

PARTICULAR consideration is given here to the more significant transport aircraft designed specifically for military operation, though the importance is recognized of the Service versions of such machines as the Boeing Stratocruiser, Douglas DC-6, Lockheed Super Constellation and Bristol Britannia. Notable, too, is the double-deck Bréguet 765, adopted by the French Air Force; and reference—even the briefest—must be made to the elephantine Convair XC-99, still the world's largest aircraft and still serving the U.S.A.F. Four hundred combat-equipped troops or 300 stretcher patients with attendants are possible loads. Successor to this monster will be the Douglas C-132, powered with four T57 turboprops of 15,000 h.p. and capable of carrying a 100,000 lb payload. The C-132 is likely to follow the general pattern of design established by the Lockheed C-130 and Douglas C-133.

Pure-jet aircraft—already represented by the R.A.F.'s Comet 2s—will first enter the service of the United States as the Boeing KC-135 tanker/transport.

Not entirely clear (having regard to the promise shown by STOL—short landing and take-off—machines) is the future in military operations of the very large helicopter, though the class is represented in these pages. In the tactical rôle its possibilities are shown by the Sikorsky H-34—the U.S. Army's version of the anti-submarine HSS—which delivers, ready to fire, a 105 mm howitzer weighing about 5,000 lb. The larger, twin-engined Sikorsky HRS will hoist a bulldozer.

Finally, reference must be made to the U.S.A.F. design competition for a multi-jet "combined transport and combat proficiency trainer," using small turbojets.

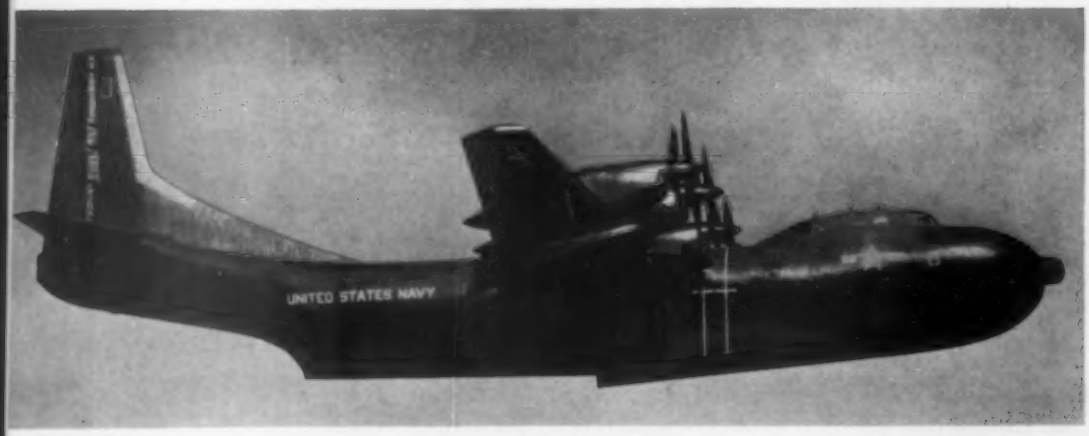
GREAT BRITAIN

Blackburn Beverley C.1 The Beverley is coming into R.A.F. service as a heavy-duty transport for the carriage of military cargo and troops and for the parachuting of troops and heavy military equipment. Designed for world-wide operations, it can be used in forward areas from very short unpaved strips. A virtually unobstructed cross-section of 10ft × 10ft is provided throughout the 40ft length of the cargo hold, and both this hold and the tail boom (which is itself of greater capacity than a Dakota fuselage) are fully soundproofed. Although a layout exists for a 162-seater, the standard troop-carrier version will be a 94-seater, with all passenger seats facing aft. As a paratrooper the Beverley carries 70 soldiers, as an ambulance 82 casualties, or as a freighter 45,000 lb—all over a distance of 200 nautical miles. Four Bristol Centaurus engines with direct petrol injection are specified, and the possibilities of installing turboprops such as the Napier Eland or Rolls-Royce Tyne are obvious.

Salient particulars (4 × 3,150 h.p. Centaurus) are: take-off weight, 143,000 lb; max. payload, 50,000 lb; max. speed 242 m.p.h., recommended cruising speed, 173 m.p.h.; service ceiling, 16,000ft; rate of climb (all engines, sea level), 760ft/min; take-off to 50ft (all engines operating), 2,910ft; accelerate stop distance, 3,780ft; landing from 50ft (reverse thrust from four engines), 2,580ft; landing from 50ft (no reverse thrust), 2,850ft.

U.S.A.

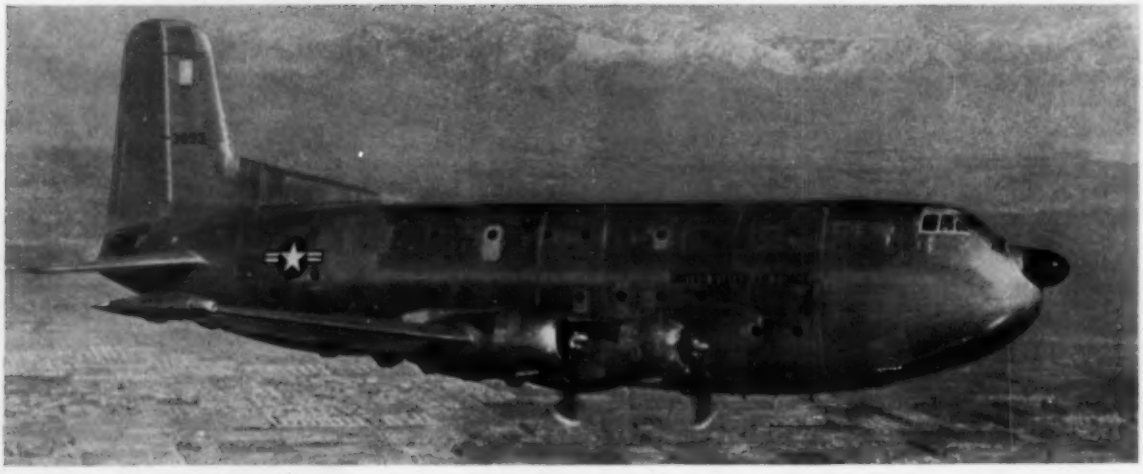
Convair R3Y-1 and -2 Tradewind The supreme example of the military transport flying-boat, the Tradewind has unique features. The -1 and -2 versions have been developed for the U.S. Navy's Fleet Logistic



Convair R3Y-1 Tradewind.

(Above) Douglas C-133A.

(Below) Douglas C-124.



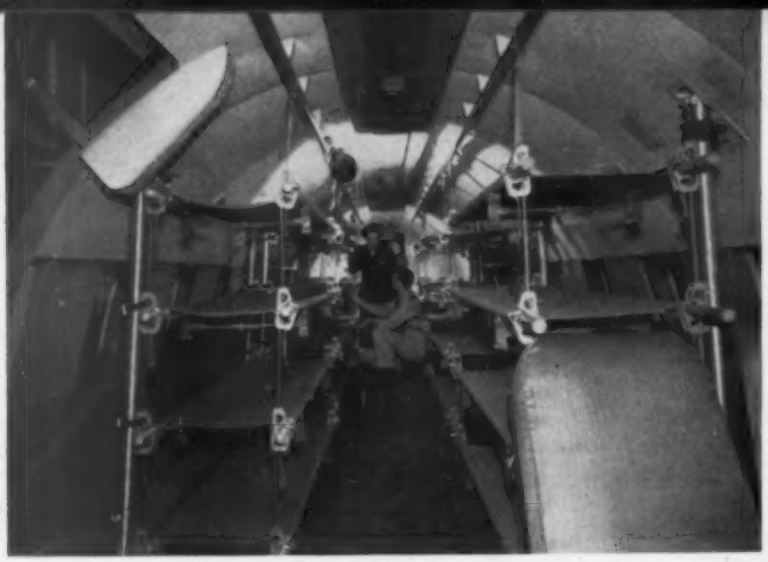
Air Wings and have a range of more than 2,000 miles and "a faster rate of climb than many World War II fighters." Gross weight is some 80 tons, maximum speed over 350 m.p.h., and take-off time with full load 30 seconds. Up to 24 tons of cargo or an assault company of Marines can be carried for the 2,000-mile distance. The -1 carries 80 passengers in rearward-facing seats, and these, in less than an hour, can be removed and replaced by 72 stretchers. Alternatively, the deck can be cleared for cargo. The -2 can be loaded through an hydraulically operated bow door 100in wide and 80in high, and an integral ramp can be extended from the opened door to load or unload directly on to a beach. The -2 carries 103 passengers or 92 stretcher cases. Its cargo deck is unobstructed from the bow door to the tail, and it can accommodate four 155 mm howitzers, three 2½-ton trucks, or six jeeps. Each version carries a crew of seven. One R3Y with four refuelling pods for the probe-and-drogue system can refuel four jet fighters at a time—and the aircraft itself can be refuelled at sea.

In April this year only one of the eleven R3Ys on order had been delivered, but the remaining ten were expected to be in service by December.

Span, 145ft; length, 142ft 6in.

Lockheed YC-130 Hercules.

Transport Facilities



Stretchers in a Convair C-131A Samaritan.

(Above) Bow-loading doors and retractable ramp of Convair R3Y-2 Tradewind.

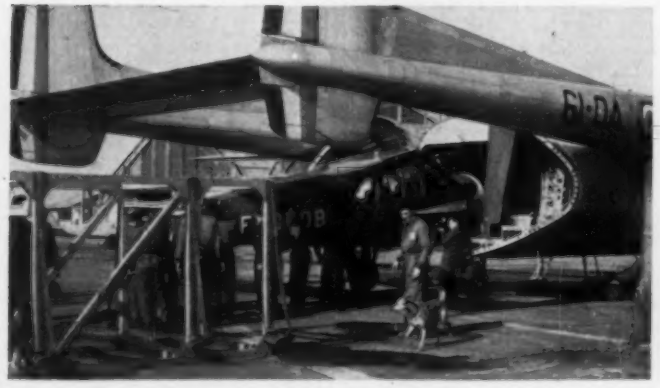
(Upper right) Unloading a tank from a Breguet Deux Ponts.

(Below) Rearward-facing troop seats in a Douglas C-118.

(Above) A Vertol H-21 lifting a jeep.

Loading demonstration of a Blackburn Beverley C.1.

A Fairchild C-119 drops a 105 mm howitzer.

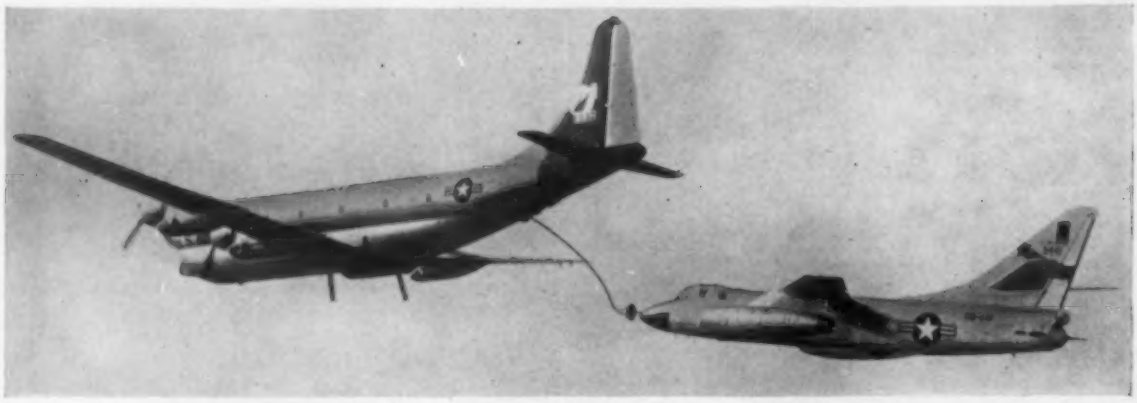


Loading a Max Holste Broussard on a Nord 2510 Noratlas.

Attaching a 4.5in rocket launcher to a Sikorsky HRS.

A tanker laden with jet fuel is loaded aboard a Lockheed C-130 Hercules.

The forward fuselage of a Vertol H-21 helicopter being taken aboard a Douglas C-124 Globemaster II.



A Douglas RB-66 refuelling by the probe-and-drogue method from a Boeing KC-97.

MILITARY AIRCRAFT 1956

Transports

Douglas C-124 Globemaster II More than 400 of these transports are in service with the U.S.A.F.'s Troop Carrier Command, Military Air Transport Service, Strategic Support Squadrons, Logistic Support Squadrons, and with a Combat Cargo Air Division. Weighing 185,000 lb all-up, the Globemaster can carry up to 55,000 lb of payload for 1,000 miles and return to base without refuelling. Possible loads are 200 fully equipped troops or "94 per cent of all military vehicles, fully assembled." This, it is claimed, means that a fleet of C-124s can move across the Atlantic or Pacific oceans an entire infantry division, including all the millions of pounds of supplies required for its equipment and support. As an ambulance 127 stretcher cases can be taken.

Since going into operation the C-124 has exceeded its design load-carrying capacity by taking off at 194,500 lb. At this weight a payload of about 50,000 lb can be carried for a range of over 2,500 miles, with reserves. Over lesser ranges the payload can be increased to more than 70,000 lb.

Indicative of the C-124's potentialities as a paratroop machine was Operation Test Drop at Fort Bragg. Nine Globemasters on that occasion dropped "more paratroopers simultaneously from fewer aircraft than ever before." Later the same nine dropped simultaneously 360,000 lb of supplies, each discharging 20 packages of 2,000 lb each.

It is known that the 18th Air Force is studying a possible redesign of the aircraft to permit enlargement of the present lift door for dropping heavy equipment.

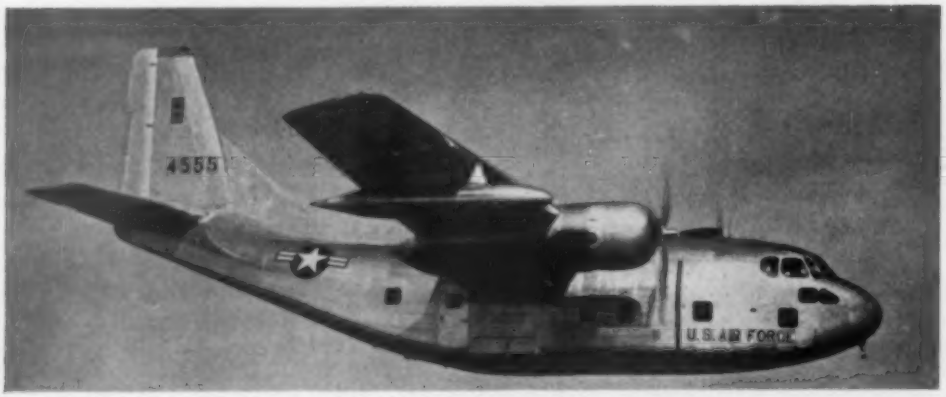
Principal particulars are : span, 174ft 2in; length, 130ft; height, 48ft 3in; empty weight, 101,052 lb; normal gross weight, 185,000 lb; max. permissible gross weight, 194,500 lb; engines, four Pratt and Whitney R-4360-63A; fuel capacity, 11,000 U.S. gal.

Douglas C-133A Until the arrival of the gargantuan C-132, briefly referred to in the introduction, this turboprop transport is likely to be the largest in production. The present powerplant is four 5,700 e.h.p. Pratt and Whitney T34s, but 7,500 e.h.p. Allison T54s are under consideration. Basically a freighter with a design gross weight of 255,000 lb, the C-133A will take up to 200 passengers, and Douglas are submitting a proposal for an air-evacuation version. The pressurized cabin can maintain a 10,000ft altitude at 35,000ft, and the pressurized area extends from the nose to a pressure bulkhead slightly aft of the main cargo-loading doors. Cruising speed "exceeds maximum level-flight speed of most World War 2 fighters." Freighting capacity is 50 short tons for more than 1,000 miles or 50,000 lb for 3,500 miles. The rear loading-door will permit a 12ft high item to be taken on to the 142in-wide floor; another opening is located on the port side near the front of the main cabin. Built into the rear door is an hydraulically operated ramp which can support 25,000 lb in a horizontal position and can be raised from the ground with a 10,000 lb load. It can readily be positioned to match varying truck or trailer-bed heights from the aircraft floor height of 50in.

The fully retractable main undercarriage consists of two twin-wheel units in tandem, in fairings on each side of the fuselage.

Span, 179ft 8in; length, 152ft 8in.

Fairchild C-123B Provider A short-field tactical transport, intended to take the place of the heavy gliders of the late war, the Provider is basically of Stroukoff design and is manufactured by Fairchild in succession to their familiar C-119 Packet. Classed by the U.S.A.F. as an



Fairchild C-123B.

Stroukoff C-123F Pantabase.

Sikorsky HR2S.

Piasecki YH-16A Turbo Transporter.

"assault transport," it is powered by two Pratt and Whitney R-2800-99W engines of some 2,500 h.p. each and has a gross weight of over 50,000 lb. Range is 850 miles with a payload of 16,000 lb. With a crew of two it is capable of air-lifting and landing 61 combat troops and their equipment; or it can carry 50 stretcher patients, six "ambulatory or walking patients," five nurses, and more than 1,300 lb of equipment on casualty evacuation flights. Other typical loads are: a 2½-ton 6 × 6 truck, two men, and 3,750 lb of equipment; a 1½-ton truck, two men, and 5,000 lb; two ¼-ton trucks, four men, and 3,400 lb; or four ¼-ton jeeps, four men, and 4,550 lb.

When artillery is required by assault forces, the C-123B can fly in and unload such ordnance as a 155 mm howitzer, 19 rounds of ammunition, and 1,300 lb of miscellaneous equipment; a 105 mm howitzer, a ¼-ton weapons carrier, six men, and 90 rounds; or a 90 mm howitzer, 90 rounds, and 6,000 lb.

Four external tanks carry the entire fuel load and reduce fire danger in that they can be jettisoned for an assault landing or in a like emergency.

Studies have been made for turboprop powerplants and flight tests have been conducted with two Fairchild J44 turbojet units, each of 1,000 lb thrust. With this augmented power, and with one engine feathered on take-off, the rate of climb has been increased from 150ft/min to 500ft/min. Interest has also been shown in the use of a Continental-built Turboméca Aspin II ducted fan for use as an air pump to feed a boundary layer control system.

Span, 110ft; length, 76ft.

Stroukoff YC-123F Pantobase This development of the basic C-123 design has a sealed hull for flotation and two sturdy skis, for land or water use, extensible from the hull bottom. The normal retractable land undercarriage is fitted, and there are outboard stabilizing floats. For water operation the skis are lowered and, by virtue of lateral aerofoils, surface at about 20 m.p.h. Notwithstanding the numerous modifications and additions, cruising speed is given as 179 m.p.h. The YC-123F has taken off from an ice-and-snow runway at a weight of 55,165 lb. The previous "record" for unassisted ski take-off was held by a Lockheed Neptune, at 52,800 lb.

Lockheed C-130A Hercules Since our previous review new facts have been disclosed concerning this remarkable machine. Classed by the U.S.A.F. as a "medium combat transport," it is powered by four Allison T56-A-1 turboprops, has a design gross weight (load factor 3) of 108,000 lb, or an "alternate gross weight" (load factor 2.5) of 124,200 lb. Take-off thrust can be augmented by eight Aerojet 15KS-1000 rockets, giving a total of 8,000 lb thrust for 15 seconds' duration. The main cargo compartment is 41.45ft long, 10.25ft wide, and 9.1ft high, and corresponding dimensions for the main loading door are 10ft, 9.2ft, and 3.4ft.

The normal crew numbers four and alternative to 92 troops, 64 paratroops, or 70 stretcher cases plus attendants can be accommodated. Features include integral ramp and cargo door; crew- and cargo-compartment pressurization; ground and in-flight air-conditioning; thermal de-icing system for wing and empennage leading-edges; armour protection against small-arms fire for pilot, co-pilot and engine nacelles; single-point refuelling; E-4 autopilot; provision for rearward-facing passenger seats; provision for "push-button spot drops of up to 25,000 lb supplies"; and an airstream deflector for paratrooping.

It is known that a "pantobased" version—suitable for operation from water, land, mud, ice or snow—is under development.

Full performance figures have not been made known, but the Hercules is said to take off with a 20-ton load in 12 seconds, or, at an all-up weight of 110,000 lb, "in twelve times its own length."

Span, 132.6ft; length, 95.2ft.

Piasecki YH-16A Turbo Transporter This great helicopter, with two Allison YT38-A-3 turboprops, is the prototype of the YH-16B, which is intended as the production version, though its future is at present in doubt. The YH-16A weighs over 16 tons and has been paced by a fixed-wing aircraf at a speed of 166 m.p.h.

Sikorsky HR2S-1 The production version of this assault helicopter, designed primarily for the Marine Corps but also to be used by the U.S. Army under the designation H-37A, differs from the prototype in having twin main wheels, improved cooling, a slab tailplane and faired rotor head. It was designed to carry two Marine squads (26 men) or two jeeps plus crews. Gross weight is between 28,000 and 30,000 lb, and top speed, with two Pratt and Whitney R-2800 piston engines derated to 1,900 h.p. each, is between 150 and 160 m.p.h. Developed models will have Allison turboprops.

Boeing B-52 refuelling by the flying-boom method from the Type 707 (precursor of the KC-135).

Auster A.O.P.9.

(Right) Saunders-Roe Skeeter 6.

SPOTTING and LIAISON

PICTURED on this page are some of the more recent and typical machines utilized for artillery spotting and observation and for liaison (communications) flying. An apparent intruder at the bottom right-hand corner is the jet-propelled Cessna T-37, which, while it might more fittingly have been included under "Trainers," is given a place here because ten have been ordered for service-test by the U.S. Army as artillery observation (A.O.P.) machines. It is felt that light aircraft of this class must succeed present piston-engined types (typified by the Cessna L-19/OE-2 series) in the observing and adjusting of fire for the Honest John and Wac Corporal ground-to-ground rockets and 280 mm atomic cannon. A British representative of particular interest is the Saunders-Roe Skeeter helicopter at the top of the page, ordered as an air observation post for the Army instead of the Fairey Ultra-Light tip-jet helicopter which was being developed for the same rôle. The Morane-Saulnier Paris represents (with its twin jets, high speed and useful range and capacity) a class of liaison aircraft which may eventually supplant such types as the Beechcraft L-23B, also illustrated.

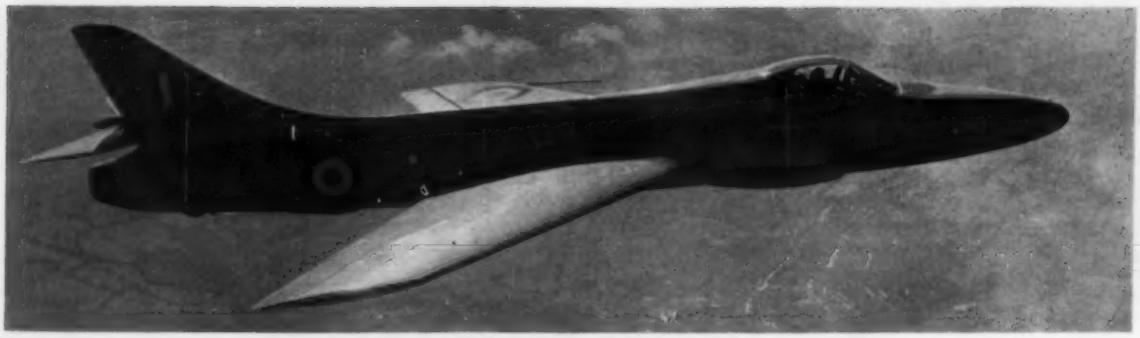
Beechcraft L-23B.

Morane-Saulnier M.S.760 Paris.

Cessna OE-2.

(Below) Cessna T-37.

(Below) Bell H-13H.



Hawker Hunter Two-Seater.

Hunting Percival Jet Provost.

TRAINERS

THREE trends are particularly apparent in the development of modern trainers and training systems: the increasingly wide acknowledgment—if not immediate acceptance—of jet-propelled trainers for *ab initio* instruction; the now-general adaptation of standard combat aircraft—including the very newest supersonic fighters—for "combat proficiency" training (and, as we have seen, for tactical employment also); and the recognition—in an order for a new Northrop machine for the U.S.A.F.—of a specialized type for supersonic instruction. We have already alluded to the jet transport/trainer now under review in the U.S.A.

GREAT BRITAIN

de Havilland Vampire Trainer The Vampire Trainer is the most widely used machine of its type in the world and is outstanding for its versatility and ease of handling. All R.A.F. pilots now earn their wings on the type and usually go solo after about 6¼ hours, having received *ab initio* instruction on the Hunting Percival Provost or Jet Provost. Instructor and pupil sit side by side in a pressurized cockpit with clear-view canopy. Ejection seats are fitted, and provision is made for instruction and practice in fighter navigation, combat, bombing, gunnery and rocket firing. With two 20 mm guns and full internal fuel it is possible to carry several combinations of rockets, bombs and external tanks. For rocket instruction eight 25 lb or 60 lb projectiles can be carried in addition to two 100-gal external tanks. Without the latter it is possible to carry practice bombs or two 500 lb bombs in addition to rocket projectiles. Two 1,000 lb bombs can be carried in place of the tanks, but not normally with rockets fitted. Should the machine be required for operational service it can be operated as a single-seater with the full fighter complement of four 20 mm guns. A cine camera in the nose operates for both rocket and gun firing, and can be used during dive-bombing attacks.

Span, 38ft; length, 34ft 6in; gross weight, 11,680 lb; max. speed, 538 m.p.h.

Hawker Hunter Two-Seater This new version of the Hunter is intended not only as a trainer but "to open up opportunities for even wider tactical rôles." Aft of the intakes it is identical with the Mk 4, but forward of this point the nose is entirely new. The cockpit has two gun-sights and two Martin-Baker lightweight ejector seats. The canopy is a fine piece of plastic moulding. Two 30 mm Aden guns are fitted in streamlined housings under the cockpit.

Hunting Percival Jet Provost T.2 Compared with its predecessor this mark of the Jet Provost has a more powerful Armstrong Siddeley Viper turbojet and a completely revised and much shortened undercarriage. Improvements have also been made to the cockpit. Performance has been improved by these modifications and take-off and landing runs are considerably shorter. Rate of climb is increased by 350ft/min at sea level.

A number of Jet Provosts are now undergoing service trials with the R.A.F. The following is an extract from *Flight*'s very detailed account

Hunting Percival Provost T.1 adapted for armament training and offensive operations.

de Havilland Vampire Trainer (Vampire T.11).

MILITARY AIRCRAFT 1956

Trainers

Lockheed T2V-1 SeaStar.

Convair TF-102A.

of the type in the issue of May 6, 1955: "If the Jet Provost were used in place of the piston-engined machine it is calculated that at least 30 hr could be cut from the Vampire syllabus and, in effect, added to the Jet Provost time. Thus the flying-training course might begin with 150 hr on the Jet Provost, during which time the pilot would be amassing jet experience, using oxygen, flying high, and getting used to aircraft which have no torque or slipstream, as such, and which burn up fuel rapidly at low level. Training would then be rounded off by about 80 hr on the Vampire. This sequence would probably cost no more, and possibly much less, than that now employed."

Miles Student The Student is a single- or twin-jet trainer with side-by-side seating, and adaptable, as a four-seater, for fast communications work, or in emergency for ground attack. Thought has also been given to an A.O.P. version with a centre-section of increased span, full-span slots and slightly modified flaps. A bogie landing gear has been projected for this model to give rough-ground efficiency, and special observation windows and a camera installation would be fitted in place of the right-hand controls. The Student will be available either with one Blackburn Marboré 2, or two Palas 600s. Very large doors are provided and the floor of the aircraft is only 18in above ground level. The undercarriage retracts into the fuselage.

U.S.A.

Beechcraft Model 73 Jet Mentor Designed as a private venture, as an "off-the-shelf" jet trainer, the Model 73 uses major components of the piston-engined T-34 Mentor—bears, in fact, the same relationship to that machine as does the Hunting Percival Jet Provost to the Provost. It is designed for an 11.25g load factor and has a maximum speed of 295 m.p.h. at 15,000ft, a stalling speed of 65 m.p.h., and a "never exceed" speed of 500 m.p.h. Gross weight is 4,520 lb. The engine is a Continental J69-T-9 (Turboméca Marboré built under licence).

Carma Jet Trainer One of the new light jet trainers, this is powered by a Continental J69-T-9 of 920 lb, weighs 3,440 lb all-up, and has a top speed of over 300 m.p.h. Span is 27.7ft.

Cessna T-37A The "A" model of the T-37 will be the U.S.A.F. production version, based on the prototype shown on page 754. The design was selected from among eight submitted to a U.S.A.F. specification. Two Continental J69 turbojets are fitted and seating is side-by-side. Gross weight is about 5,600 lb and maximum speed over 350 m.p.h.

Convair TF-102A The entire forward fuselage of the basic F-102 all-weather fighter has been redesigned, in this model, to accommodate side-by-side seats. The TF-102A represents the new class of supersonic training aircraft and four will be supplied to each squadron of 21 single-seaters. This is expected to result in "greater pilot proficiency and in a reduction in the loss of aircraft and pilots due to reduction in accidents."

Grumman F9F-8T Cougar Reference has already been made to this two-seater under "Multi-Seat Carrier-Based Fighters." The second cockpit has been added forward of the original, and the machine is said to retain all the speed, range and flying characteristics of the single-seater.

Lockheed T2V-1 SeaStar One of the most interesting trainers in production, this is a development of the T-33 for the U.S. Navy. Tandem seating is retained, but the rear seat has been raised six inches to improve the field of view. Perhaps the most notable feature is the fitting of a boundary-layer control system for the flaps. This takes bleed air from the Allison J33-A-24 turbojet and discharges it over the flap through a .030in slot along the rear of the wing. Automatic leading-edge slats are also fitted, with the result that, although the

Grumman F9F-8T Cougar.

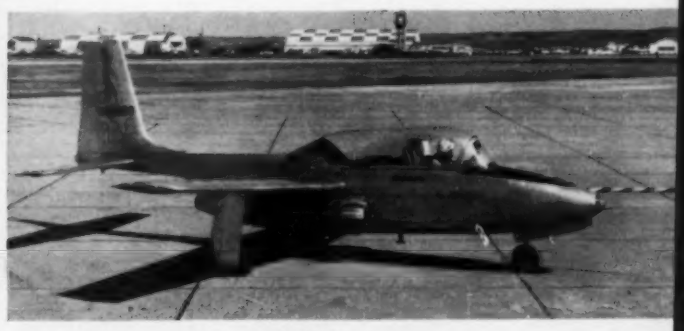
Beechcraft Model 73 Jet Mentor.

top speed is nearly 600 m.p.h., landing speed is kept down to 97 m.p.h. Normal gross weight is 15,500 lb and maximum take-off weight 16,800 lb.

Temco Model 51 The Model 51 achieves 345 m.p.h. at 15,000ft. Service ceiling is 35,000ft and endurance at sea level, with normal fuel, is 1½ hr. At normal landing weight, with flaps, the stalling speed is 69 m.p.h. Maximum diving speed is 515 m.p.h. and sea-level rate of climb 1,900ft/min. Developed as a private venture, the machine is a tandem two-seater and has ejection seats, a liquid oxygen system, and hydraulically operated air brakes. The Continental YJ69-T-9 turbojet can be completely changed in about 20 min.

FRANCE

Fouga CM.170R Magister The Magister is in quantity production for the French Air Force and, after evaluation alongside other French and foreign trainers, was declared by NATO to be "the best-adapted aircraft for the modern type of operational training." The makers remark that France is the only country to have been able to compare both the tandem and side-by-side arrangement in jet trainers, and that not only the French authorities, but NATO also, preferred the tandem layout. This they considered to be of considerable importance from the point of view of "flight configuration," the aiming of guns and rocket projectiles, and formation flying, and they reason that from the very beginning the pupil is accustomed to being in a single-seat cockpit. The Magister is fitted to carry two 7.5 mm guns and a camera gun, and four 55 lb rocket projectiles or two 110 lb bombs. A periscope provides the instructor—in the rear cockpit—with an adequate sighting view. Empty and gross weights are, respectively, 4,270 lb and 6,100 lb, and maximum speed at 29,500ft is 444 m.p.h. Sea-level rate of climb is 3,350ft/min and take-off run 550-650 yd. Maximum endurance is 2 hr 40 min.



Temco Model 51.

Convair T-29 Flying Schoolroom.

Fokker S.14.

(Upper right) Fiat G.82.

Fouga Magister.

UTILITY

DIVERSE as are the machines illustrated, they represent only a few of the types in service for "utility" duties, by which is implied light transport, ambulance work, search and rescue, trials observation and radar calibration. Especially valuable are such machines as the fixed-wing Prestwick Pioneer, which rivals the capabilities of the helicopter. Canada's tough bush aircraft, the Beaver and Otter, have appealed to military as well as civil operators, and are represented by a U.S. Army Otter. There are, too, experimental convertiplanes, "normal" helicopters, an amphibian, and the conventional, though adaptable, Hunting Percival Pembroke.

Not exemplified are the numerous pilotless target aircraft and the radio-controlled "drones"; and we are not allowed to depict the Lockheed U-2 high-altitude weather-research and test aircraft. Something of a mystery at the time of going to press, this is said to be suitable for studying jet streams, for investigating turbulence and gusts, and for examining air for cosmic ray particles, ozone and radio active content.

Scottish Aviation Prestwick Pioneer.

Westland Whirlwind.

Hunting Percival Pembroke.

(Above) Bell XH-40 (mock-up). (Below) Soviet Mi-4.

D.H. Canada Otter (U.S. Army U-1).

Bell XV-3 experimental convertiplane.

McDonnell XV-1 experimental convertiplane.

Grumman UF-4 Albatross.

(6) MERITS OF THE GNAT

Versatility

The Gnat jet fighter fills three separate and distinct roles — interceptor, tactical and naval. As an interceptor it carries two 30-mm. cannon, identification equipment, radar gun ranging, navigational and homing aid and V.H.F. (or U.H.F.) radio and standby set. In its tactical role, operating from reinforced grass runways, it carries two 30-mm. cannon and two 60-gal. drop tanks plus 2 × 500-lb. bombs, or 12 × 3-in. rockets or two Napalm bombs. Alternatively, it can carry two 30-mm. cannon and 18 × 3-in. rockets, or two 30-mm. cannon and 6 × 3-in rockets and 2 × 500-lb. bombs.

As a carrier-borne fighter it has two 30-mm. cannon, standard naval instruments and equipment, one hour's internal fuel, or two hours' fuel with external tanks; it requires no wing folding and therefore escapes the weight and performance penalties imposed upon conventional naval fighters, and takes up little stowage space.

IN SPEED, RADIUS OF ACTION, CLIMB, SERVICE CEILING — IN ALL IMPORTANT FEATURES OF FLYING AND OPERATIONAL PERFORMANCE — THE GNAT LIGHT FIGHTER MORE THAN MATCHES THE CONVENTIONAL FIGHTER. ITS EXCELLENT STABILITY MAKES IT A STEADY AIMING PLATFORM. ITS SMALL SIZE, SIMPLE STRUCTURES AND SERVICES MAKE IT EASY TO PRODUCE AND MAINTAIN.

WHERE THE GNAT ALSO SCORES

Judged by conventional fighter standards, the Gnat

(1) has a higher service ceiling, higher rate of climb and better manoeuvrability;

(2) combines hard-hitting armament with exceptional stability at all speeds;

(3) can be transported more easily, and is less exacting in its airfield requirements;

(4) is easier to produce;

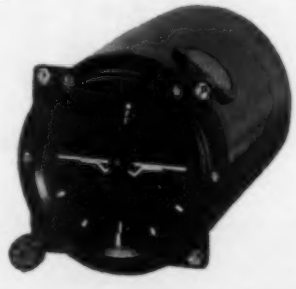
(5) is easier to maintain;

(6) costs far less to buy and operate.

FOLLAND *Designed and Built by the Pioneers of the Light Jet Fighter*

FOLLAND AIRCRAFT LIMITED · HAMBLE · SOUTHAMPTON · HANTS

The high performance military aircraft of today have to operate with a very limited fuel reserve and at altitudes which frequently involve a let-down through the overcast to bases with restricted visibility. Thus the provision of continuous and precise attitude information is vital. The Sperry Mark 3C Gyro Horizon fully meets this requirement even when aerobatic manoeuvres have been executed immediately prior to the let-down. This instrument is the latest development of the highly successful series of electric gyro horizons Sperry have produced in the past, involving thousands of hours of research and millions of hours of operational service. It is useful under all flying conditions — invaluable in SPERRY WEATHER.



SPERRY

Mk. 3C Gyro Horizon

SPERRY GYROSCOPE COMPANY LIMITED · GREAT WEST ROAD · BRENTFORD · MIDDLESEX · *Telephone: EALing 6771*

The prototype Britannia 100, G-ALBO, seen in its new red and white colour scheme. This aircraft is operated by Bristol Aero Engines Ltd., and has just completed tropical trials in Africa to test the newly modified Proteus engines ("Flight," May 18).

CIVIL AVIATION

CAPITAL COME SHOPPING

MAKING his second visit to England in seven weeks, Mr. Jim Carmichael, president of Capital Airlines, said before leaving New York: "I am leaving on a continuing exploratory investigation of new airliners being manufactured in England . . . We need airplanes." Mr. Carmichael arrived with his chairman, Mr. George Hahn, and Capital's treasurer, Mr. Raymond Lochiel. He was met at London (where he arrived by B.O.A.C. Stratocruiser) by Mr. Peter Masefield, managing director of Bristol Aircraft.

By the time these words are read Mr. Carmichael and his colleagues will be on their way back to Washington and—if speculation and unofficial reports are any guide—it may well be that they will have placed a firm order for the Britannia. Our U.S. contemporary *Aviation Week* states that an order for 15 aircraft with an option on a further number is "expected" to be placed by Capital and, by arrangement with B.O.A.C., five of them—mark 300s—could begin to be delivered in the autumn of next year. This would be a full year in advance of the Electra deliveries to American, Eastern, Braniff and National. Mr. Carmichael said that he considered the Britannia "ideal" for such routes as New York to Chicago and Washington to Chicago. The other ten Britannias would be to a Capital specification based on the Mark 310 and designated 315—a medium-range version of the 310 with reduced tankage.

Twenty-three of Capital's order for 60 Viscounts have now been delivered and the American party paid a visit to Weybridge for further discussions on this aircraft and on the Vanguard. A visit was due to be made also to Hatfield, and it seems there are good grounds for believing that the persistent reports that Capital are considering the purchase of de Havilland Comet 4s —a figure of 30 has been mentioned—are more than speculation.

Unofficial reports of a new Britannia development, the Mk 400, state that it is a development of the 310, with Bristol B.E.25 Orion turboprops and a 10ft increase in fuselage length.

As reported in the news item above, a party of Capital Airlines' executives has been in England to discuss the purchase of British aircraft, including the Britannia. Seen here are (left) Mr. James Franklin, vice-president operations, and Mr. James A. Austin, vice-president sales. Mr. Carmichael, president, followed later.

BY AIR TO MOSCOW

THE possibility of a new B.E.A. service to Moscow, mentioned in our editorial last week, still seems to be some way off. The discussions in Moscow last November between the Corporation and Aeroflot about an interline agreement have so far come to nothing because, as is now known, of the Foreign Office's hesitation to approve an intermediate airport—Schoenefeldt in East Berlin and Templehof in the U.S. sector of West Berlin were considered—as the interconnecting point for the two airlines. In the meantime the Russians have sought discussions with the American, French and German governments to consider an exchange of traffic rights, and have of course already started operations in association with S.A.S. and Finnair.

B.E.A. are undoubtedly eager to open a service to Moscow—preferably as a through operation. Certainly the complication of a change-over point *en route* seems unnecessary. B.E.A. are however unable to make any comment on the matter, which, as with all interline agreements, requires the approval of the governments concerned before services can begin.

TO DINARD THE EAGLE WAY

ON the afternoon of Friday, May 18, Viking G-AJBF *Mayfair* of Eagle Aviation took off from Blackbushe on the inaugural flight of a new scheduled service to Dinard-Pleurtuit. This was an historic occasion, not only for Eagle but for all British independent airlines, because an international scheduled service out of London was being opened in competition with a national air corporation.

This is the first time that such a service has been allowed to operate. Four airlines—B.E.A., Air France, Jersey Airlines and Eagle—are now using Dinard-Pleurtuit. Of these, only Jersey Airlines maintains an all-the-year-round service.

Yesterday, June 7, a Viking of Eagle Aviation was due to take a party of eleven fashion models to Moscow. Flying from Blackbushe by way of Berlin and Warsaw, Eagle's Viking was due to arrive at the Russian capital—the first British civil aircraft to do so since the war—late last evening.

FLY NOW, PAY (MUCH MORE) LATER

THE hire-purchase air travel plan introduced on April 1 by South African Airways and B.O.A.C. does not seem to be proving popular with the majority of passengers in South Africa, a correspondent reports. Apparently, the high rate of interest charged (about 19 per cent) has discouraged prospective passengers. Under the 21-month deferred-payment plan a couple flying to England and returning to the Union have to pay an extra £95.

Commenting on the high rate of interest, an S.A.A. official said that the scheme was a bad credit risk. "People who travel forget the trip and are reluctant to keep up heavy instalments on something which is just a memory. It is not like a car or refrigerator, where the payer has something tangible to show for his money, and the proportion of bad debts on air travel hire-purchase is high." It was "too soon to say" if the scheme would increase in popularity but, by introducing hire-purchase in air travel, the modern trend was being followed.

On June 1 a scheme for the hire-purchase of tickets for flights from Southern Rhodesia to points outside was started. Operated by B.O.A.C., S.A.A., East African Airways and Central African Airways, the scheme is valid for flights costing more than £30 and requires a 10 per cent deposit.

CIVIL AVIATION . . .

AT the opening of the I.A.T.A. Traffic Conference on May 29, M. Rene Lemaire of the French Government delegation said that certain European governments were "worried" about the PanAm and T.W.A. plan to cut transatlantic fares. He hoped that a "just solution" would be found, leaving European countries time to adapt themselves.

* * *

Following the threat of B.O.A.C. engine maintenance men to strike if Britannia engines were overhauled by the makers, B.O.A.C. have agreed that the "bulk" of Proteus work will be undertaken in the Corporation's own establishments.

The address of the Air Registration Board's head office is to be changed from July 2 to Chancery House, Chancery Lane, London, W.C.2, telephone number Chancery 2811.

* * *

A Viscount on a proving flight from Bergen to London landed at Sumburgh Head, Shetland, and later at Kirkwall, Orkney, on May 29 to ascertain whether these small aerodromes are suitable for regular Viscount operations.

* * *

Lufthansa's U.K. sales and operations representative to succeed Mr. Bernd Barg, who is returning to Cologne as general sales manager, is Mr. Joachim von Frankenburg.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

America and the Speed Record

ON page 623 of your May 18 issue there is an Editor's note that implies a formal try has been made by the F-104 for the official world speed record. I have heard similar rumours from your side of the water for several weeks now, so there seems to be a very strong impression that this is true.

I can assure you that no such official or unofficial attempt has been made by either the XF-104 or the F-104A. Charley Logsdon, the official National Aeronautic Association timer, tells me that neither he nor any of his people or their high-altitude speed-course equipment at Edwards A.F.B. have been involved in any such official or unofficial operations. My good friends, both military and civil, who have flown both F-104 models tell me the same.

Perhaps these rumours got started over a series of preliminary runs by the Vought F8U last year, before the Fairey record, when Vought was aiming at a 1,000 m.p.h. record. The F8U did make a series of dry runs over the N.A.A. course preparatory to an official attempt but this official attempt was cancelled by order of the Defense Department just 48 hours before it was scheduled to go. The F8U was deliberately flown at something less than full bore for security reasons, as was the F-100C during Horace Hanes run. The F8U hit an average over 1,000 m.p.h., but under the Fairey 1,132 m.p.h. mark.

I think you are correct in assuming as you did in a recent leader that it is Lockheed that will be heard from on the speed record and perhaps late summer will be the time. In the meantime, look for some startling X-2 news before the end of June.

Washington, D.C. ROBERT B. HOTZ,
Editor, *Aviation Week*.

D.H.9s G-AACP and G-AADU

FURTHER to the correspondence printed in your recent issues regarding the above aircraft, I enclose photographs of the machines that perhaps can be reproduced, as I am sure they will prove of interest to both Mr. M. P. Sayer and Mr. P. M. H. Lewis.

These two aircraft were rebuilt by the late Mr. C. B. Field of Kingswood, Surrey, in 1936 during the time I was employed by him, and I believe that they were originally owned by Sir Alan Cobham. They were, as your correspondent points out, used for banner towing, and we did use one at Ford as a camera platform during some of the early flight refuelling experimental flying for Sir Alan.

The reason why we painted them "a nauseating mauve colour" was to draw attention during banner-towing operations.

Epsom, Surrey. W. H. MARES.

Mr. Mares' photograph of one of the three-seat D.H.9s.

Australia's Historic Lancaster

I HAVE read with interest the letter of Australian correspondent John Hefferman in *Flight* of May 11, with regard to Lancaster "G for George."

I believe the serial number of this aircraft to be W4783; it spent most, if not all, its operational life with No. 460 Sqn., R.A.A.F., based at Breighton, East Yorks, and then at Binbrook, Lincs.

I can confirm that it did indeed do at least 90 "ops." Fifty-five of these operations were done with one F/O. Alec St. Smith, an Australian, as captain, who took over the aircraft when new, when the squadron converted from Pratt and Whitney powered Wellington IVs. This officer was subsequently posted missing after an operation whilst flying Mosquitoes.

Incidentally, the letters of No. 460 Sqn. were "UV" whilst stationed at Breighton, but were changed to "AR" when the squadron was moved, along with all the remaining No. 4 Group squadrons, from Yorkshire to Lincolnshire sometime in late 1942 or early 1943.

As a matter of interest, the major proportion of personnel and small equipment was "air-lifted" from Breighton to Binbrook, using some 20 or 30 Horsa gliders, with Albemarles as the tug aircraft.

North Ferriby, E. Yorks. GEOFFREY B. DUCKER.

FORTHCOMING EVENTS

June 5-8. Institute of Transport: 1956 Congress, Southport.
June 9. College of Aeronautics, Cranfield: Open Day.
June 9. Royal Air Forces Association, Northern Ireland H.Q.: Air Display, R.N.A.S. Sydenham, Belfast.
June 10. Leicestershire Aero Club: At Home.
June 15-17. Palmero Aero Club: Eighth Tour of Sicily.
June 16. R.N.A.S. Eglinton, Northern Ireland: At Home.
June 16-17. Popular Flying Association: National Air Rally, Shoreham.
June 16-18. Federation of Belgian Aero Clubs: International Rally.
June 20. Institute of Navigation: "Crossing Antarctica," by George Lowe. Navigation problems outlined by S/L. John Lewis.
June 22-24. Royal Netherlands Aero Club: Air Tour of Holland.
June 23. R.N. Air Electrical School, Worthy Down, Winchester: At Home.
June 23. Elstree Flying Club: At Home and Flying Display.
June 24. Royal Netherlands Aero Club: Seventh Competition for Free Balloons, Nijmegen, Holland.
June 28-30. Aero Club of Massa Apuania: Air Rally.
June 29-July 1. Pescara Aero Club: Fourth Annunzio Trophy.
June 29-July 13. World Gliding Championships, St. Yan, France.
June 30-July 1. Aéro-Club de Basse Normandie: Ninth Air Rally.
June 30-July 2. Royal Aero Club: Private Rally, La Baule.
July 6-14. OSTIV: Sixth Congress, St. Yan.
July 7-9. Royal Aero Club: Private Rally, Deauville.
July 14-15. Aero Clubs of Trento and Bolzano: Eighth International Tour of the Dolomites.
July 14-15. Dusseldorf Aero Club: Air Rally.
July 14-25. International Gliding Competition, for the Coupe Jacques Coeur, Bourges.
July 15. Royal Belgian Aero Club: International Gliding Competition.
July 15. R.Ae.S.: Garden Party, Wisley.
July 21. R.Ae.C.: National Air Races, Third Round (including King's Cup Race), Baginton, Coventry.
July 21. R.N.A.S. Lossiemouth: At Home.
July 21. R.N.A.S. Anthorn: At Home.
July 22. Northamptonshire Aero Club: At Home.
July 28. Lasham Gliding Centre: At Home.
July 28. R.N.A.S. Yeovilton: At Home.
July 28. R.N.A.S. Culdrose: At Home.
Sept. 3-9. S.B.A.C. Display, Farnborough. ("Public" days, 7th, 8th, 9th.)

DAVID BROWN
Aircraft Tractors

A David Brown VIG/IC with a Bristol Britannia in tow.

. . . the choice of the experts

Ministry of Supply · Royal Aircraft Establishment · British Overseas Airways Corporation · Trans-World Airlines · Malayan Airways · Burma Airways British West Indian Airways · Aereo Portuguesa · K.L.M. Royal Dutch Airlines · Qantas Airlines · Blackburn and General Aircraft Co · Bristol Aircraft Corporation · De Havilland Aircraft Corporation · Vickers Supermarine · Westland Aircraft · A. V. Roe · Folland Aircraft · Airwork · Silver City Airlines Fleet Air Arm · Royal Air Force · Royal Australian Air Force · Royal Canadian Naval Air Service · Royal Canadian Air Force · Royal New Zealand Air Force Royal Pakistan Air Force · Royal Danish Air Force

DAVID BROWN • EUROPE'S LARGEST MANUFACTURERS OF AIRCRAFT TRACTORS

DAVID BROWN TRACTORS (ENGINEERING) LTD. • INDUSTRIAL TRACTOR DIVISION • HANWORTH PARK • FELTHAM • MIDDLESEX

WESTON

AIRCRAFT INSTRUMENTS

The Model S.122 Form 4 is a high pressure transmitter having ranges of from 0-400 p.s.i. up to 0-6000 p.s.i. The transmitter is contained in a die-cast aluminium case and consists basically of a special form of Bourdon tube which, when under pressure, moves laterally, causing a change in the position of a contact arm wiping across a resistor.
The resultant variations are led away from the transmitter through a three-pin plug, and are fed to a ratiometer indicator operating from the nominal 24 volt supply. The instrument is substantially independent of variations in supply voltage. The working life of this transmitter is unaffected by large and high frequency pulsations in the pressure supply.
Other forms available for pressures of 40 to 120 p.s.i.

SINGLE PHASE AND POLYPHASE WATTHOUR METERS
SYNCHRONOUS TIME SWITCHES
SYNCHRONOUS MOTORS AND MOTOR UNITS

SANGAMO WESTON

PANEL & SWITCHBOARD INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron
PORTABLE INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron, A.C./D.C. Dynamometer
LABORATORY STANDARD INSTRUMENTS
D.C. Moving Coil, A.C./D.C. Dynamometer

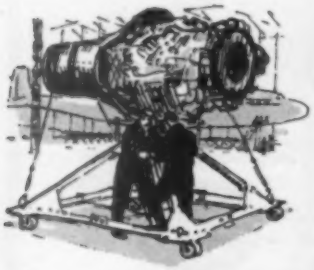
CURRENT TRANSFORMERS · FREQUENCY METERS · ALL-PURPOSE TEST SETS AIRCRAFT INSTRUMENTS · RATIOMETERS TACHOMETERS · WESTON STANDARD CELLS · ELECTRICAL THERMOMETERS "PHOTRONIC" PHOTO ELECTRIC CELLS PHOTOMETERS AND PHOTOGRAPHIC EXPOSURE METERS

SANGAMO WESTON LIMITED
ENFIELD · MIDDLESEX
Telephone: ENField 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire
Port Glasgow 41151
Branches: London, CHAncery 4971
Glasgow, Central 6208 · Manchester, Central 7904
Newcastle upon Tyne, Newcastle 26867
Leeds, Leeds 30867 · Liverpool, Central 0230
Wolverhampton, Wolverhampton 21342
Nottingham, Nottingham 42403
Bristol, Bristol 21781
Southampton, Sol'ton 23328
Brighton, Brighton 28497

SW/19

planning ahead
Design and development on projects connected with missiles are to the fore in our present programme. Comprehensive production facilities are available within our own organisation to support our design teams.
WESTERN MANUFACTURING (Reading) LTD
THE AERODROME · READING · BERKSHIRE
Telephone: SONNING 2351
Grams: HAWK, READING



In the building and maintenance of aircraft all over the world, Flexello castors are playing an increasing part. Specially designed for ground servicing equipment, they are utterly reliable under all conditions. The constant quality, closest inspection and modern methods have made Flexello the largest castor manufacturers in Europe.

Industry runs smoothly on

Flexello

CONSTANT QUALITY CASTORS

For full particulars write to Dept.156/AV

FLEXELLO CASTORS & WHEELS LTD.
SLOUGH · BUCKS · TEL. SLOUGH 24121

ACRATORK Regd

PRECISION TORQUE SPANNERS

1 *Control torque application automatically*
2 *Make overloading impossible*
3 *Do not depend on the vision, care or skill of the operator for their accuracy*
4 *Are unaffected by side loads*
5 *Give precision results with unskilled labour*
6 *Retain their accuracy for long periods of continuous use without attention*

Twelve models provide for all loads up to 850 lbs./ft.

World Distributors :

CORY BROTHERS AND COMPANY LTD.
CORYS' BUILDINGS, CARDIFF
Dept. "F"
Telephone: Cardiff 31141

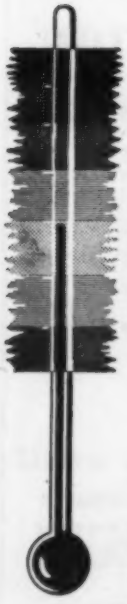
Rotor Drive by Layrub

Both the 'Bristol' Type 173 Twin Rotor Helicopter and the 'Bristol' Type 171 Sycamore Helicopter use LAYRUB as the main drive between engines and rotors. The Layrub Couplings use rubber trunnion blocks as the main driving elements. There are no metal-to-metal contacts; the drive being fully cushioned. No lubrication is required; therefore, little maintenance.

LAYRUB has been the means of solving many transmission problems, perhaps it can solve yours? Another famous Bristol Aircraft in which Layrub is used is the 'Britannia'.

A postcard will see full technical data on its way to you.

LAYCOCK ENG. LTD. · MILLHOUSES · SHEFFIELD, 8



TEMPERATURE MEASUREMENT

"Thermindex" Paints are temperature sensitive compounds which indicate by a sharp, clear cut change of colour when temperature of a surface has attained or exceeded a predetermined value. They are supplied in the form of paints suitable for direct application by brushing or spraying to practically any surface and dry quickly at room temperature. When the temperature of the treated surface is then raised, the original colour of the pigment changes sharply at a definite point and the new colour persists after the surface has cooled down.

Write Dept. AA/5 for full technical details

"THERMINDEX"

TEMPERATURE INDICATING PAINTS

Sole distributors for Europe and U.K.

Manufactured by Synthetics & Industrial Finishes Ltd.

J. M. STEEL & CO. LTD.

36-38, KINGSWAY, LONDON, W.C.2 Tel: HOL 3532

BRANCHES:
51, South King St., Manchester, 2 Tel: Deansgate 6077/9
45, Newhall St., Birmingham 3 Tel: Central 6342/3

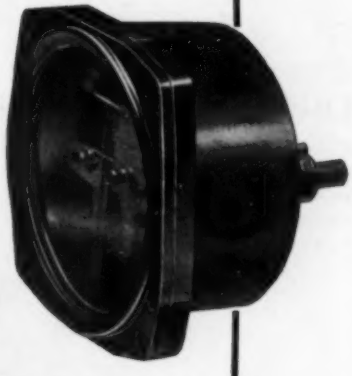
★ ★ ★ 1A189

VARIABLE RESISTANCE UNITS

TYPE H.R. FOR HEIGHT

*

TYPE A.S.R. FOR AIRSPEED AND PRESSURE



Voltage Proportional to Pitot Air Speed or to Aneroid Height Operating at 28 Volts.

R. W. MUNRO LTD.

BOUNDS GREEN - LONDON - N.11

TELEPHONE: ENTERPRISE 4422

T.T. RACES!

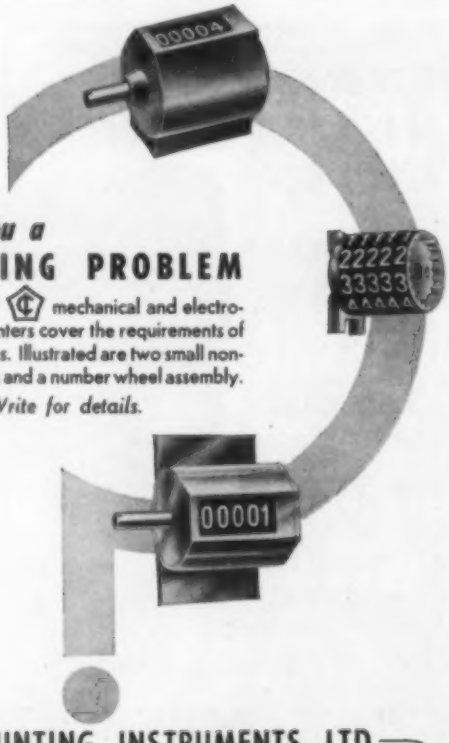
There's still time to get these 3 special issues

First-hand and finest coverage of all T.T. events! Start today with the first of three big T.T. numbers of The MOTOR CYCLE. Better place an order for the June 14 and 21 issues too, then you'll be sure of outstanding reports and action pictures direct from the Isle of Man. From all newsagents 8d.

Every enthusiast should have . . .

THE MOTOR CYCLE

T.T. NUMBERS
7–14–21 JUNE



Have you a
COUNTING PROBLEM

Our range of Ⓒ mechanical and electro-magnetic counters cover the requirements of most industries. Illustrated are two small non-reset counters and a number wheel assembly.
Write for details.

COUNTING INSTRUMENTS LTD
5 ELSTREE WAY, BOREHAM WOOD, HERTS
Telephone: ELSTREE 1382-3-4

THE
BRITISH AVIATION
INSURANCE COMPANY LIMITED
The oldest and largest office specializing in Civil Aviation

HEAD OFFICE
3-4 LIME STREET, LONDON, E.C.3
Telephone: Mansion House 0444 (6 lines)

BRANCH OFFICES

MONTREAL
276 St. James Street West, Tel: Avenue 8-6135

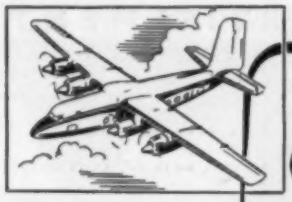
TORONTO
61 Adelaide St. East, Telephone: Empire 4-4892

VANCOUVER
626 West Pender Street, Tel: Tatlow 2167

JOHANNESBURG
London House, Loveday Street, Tel: 33-3048

CALCUTTA
2 Hare Street, Telephone: 23-3274

BRUSSELS
99 Rue de la Loi, Telephone: 12.00.05



Complete CONTROL at all times

Remote control with all movement faithfully, accurately and reliably reproduced at the receiving end.

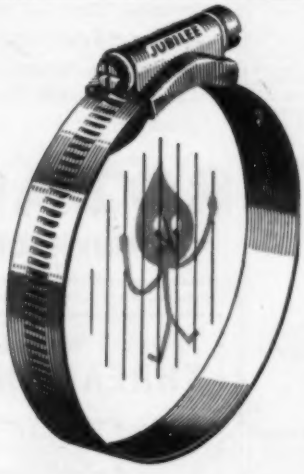
Bloctube Controls offer you all the advantages and none of the snags of other systems. No wires to stretch, hydraulic or pneumatic systems to leak or contact wear of electrical systems.

Ball-ended members in spherical sockets retained by spring-loaded cups are coupled by rigid tubes giving you trouble-free movement resistant to wear and consequent backlash.

IN OTHER WORDS

BLOCTUBE Controls "work with no play"

BLOCTUBE CONTROLS LTD
AYLESBURY · BUCKS
Tel. Aylesbury 828-9-30



there's never a drip through

a *genuine* Jubilee **clip**

L. ROBINSON & CO. (GILLINGHAM) LIMITED
London Chambers, Gillingham, Kent
Phone 5282

B T-H

EQUIPMENT for AIRCRAFT

Since the early days of the first World War, British Thomson-Houston has specialised in equipment for aircraft. The experience gained over many years is incorporated in the design, development, and manufacture of complete electric power systems, ignition systems, engine-starting systems, and all associated components.

BRITISH THOMSON-HOUSTON
THE BRITISH THOMSON-HOUSTON COMPANY LTD.,
COVENTRY, ENGLAND *Member of the AEI group of companies*
A 4968

FLIGHT
and
AIRCRAFT ENGINEER

PRESS DAY — *Classified advertisement "copy" should reach Head Office by* FIRST POST THURSDAY *for publication in the following week's issue subject to space being available.*

CLASSIFIED ADVERTISEMENTS

Advertisement Rates. 4/- per line, minimum 8/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Public Appointments, Tenders 5/- per line, minimum 10/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

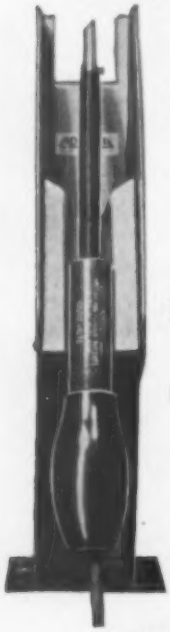
Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street, London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

ADCOLA
(Regd. Trade Mark)
SOLDERING EQUIPMENT



VOLT RANGES
6/7v. to 230/250v.

(*as illustrated*)
⅛" DETACHABLE BIT MODEL (*List No. 64*).

PROTECTIVE SHIELD
(*List No. 68*).

Apply for catalogues:
ADCOLA PRODUCTS LIMITED,
GAUDEN ROAD, LONDON, S.W.4.
Tels. MACAULAY 3101 & 4272.

"CUSTODIAN"

Still the best
QUICK ACTING
Shear Fastener
FOR CURVED OR FLAT PANELS
Write for full details
KING AIRCRAFT CORP.
HILLINGTON, GLASGOW
TELEPHONE: HALFWAY 4571
TELEGRAMS: AIRCRAFT, GLASGOW

AIRCRAFT FOR SALE

CARTWRIGHT HAMILTON AVIATION, LTD.

OFFER:—
In the Light Class
TIGER MOTH, current C. of A.
B. A. SWALLOW, current C. of A.
TAYLORCRAFT, current C. of A.
PROCTORS III, IV and V, current C. of A.
GEMINI, current C. of A.
Medium Class
RAPIDES, Dove, Consul, etc.
Commercial Class
VIKING, D.C.3, C.56, York and Skymaster.
ALSO a good selection of light and commercial aircraft for disposal.
INSPECTION and Demonstration willingly arranged.
PART-EXCHANGE and hire-purchase facilities available.
282 Kensington High Street, London, W.14. Western 0207. Telegrams: Autavia, London. [0751

W. S. SHACKLETON, LTD.

Europe's Leading Aircraft Brokers

offer a brand new

AUSTER ALPINE

WITHOUT doubt an aircraft that will prove one of the most successful in the famous range of Auster light aeroplanes. The Alpine, which has a cruising speed of over 110 m.p.h. and a still-air range of 450/500 miles, is a really efficient general purpose aircraft, equally efficient for private touring or flying training. Fitted with a Gipsy Major X engine, full blind flying panel, 32 gallon fuel system, full dual control, bench type rear seat, metal propeller and silencer. The Alpine has only just entered production, but we have one on order for early delivery.
WE invite you to write for further details.
W. S. SHACKLETON, LTD., 175 Piccadilly, London, W.1. Cable: "Shackhud, London." Phone: HYDe Park 2448-9, 9408. [0070

R. K. DUNDAS, LTD.

AEROPLANES BY DUNDAS.

PIPER COUPE. 12 months C. of A. Dual Control.
AUSTER V. Immediate Delivery.
AUSTER AIGLET. Choice of Two.
TIGER MOTH. Very low hours, one private owner.
C/46. Passenger or Freighter. Zero hours.
BONANZA. Model D35.
Aeroplanes by Dundas
ALL above aircraft are available.
R. K. DUNDAS, LTD., 29 Bury Street, London, S.W.1. Tel.: WHI. 2848. Cables: Dundassero, Piccy, London. [0559

Personal Inspection Invited

ROLLASONS

for

TIGER MOTHS

and

GIPSY ENGINES

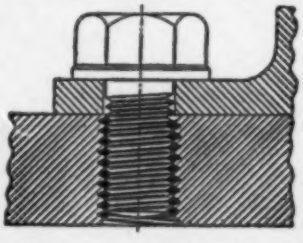
Croydon Airport, Surrey.
Phone: CRO. 5151. [0130

R51F

Skilled hands are soon out of action when dermatitis strikes. But dermatitis can be avoided — simply — by using Rozalex. For over 25 years Rozalex have specialised in barrier creams for industry. They have found the answer to most industrial skin irritants. Their full technical resources and experience are at *your* disposal on request to Rozalex Ltd., 10 Norfolk Street, Manchester 2.

ROZALEX
BARRIER CREAMS

WIRE
THREAD INSERTS



FOR NEW DESIGNS
AND SALVAGE
CROSS MFG. CO. (1938) LTD.
COMBE DOWN, BATH
TEL: COMBE DOWN, 2355/6

A HUNTING-CLAN COMPANY

FIELD'S

World Wide

PRATT & WHITNEY ENGINE OVERHAUL SERVICE

Sale · Exchange and Overhaul

CONTRACTORS TO
The Ministry of Supply and
United States Air Force

A.I.D. & A.R.B. Approved

Details on application to

FIELD AIRCRAFT SERVICES LTD.

CROYDON AIRPORT · CROYDON · SURREY

Phone: CROYDON 7777
Cables: 'FIELDAIR', Croydon

A HUNTING-CLAN COMPANY

AIRCRAFT FOR SALE

MITCHELL AIRCRAFT, LTD.

PROCTOR V. C. of A. until February, 1957. Engine hours 520 since overhaul. Excellent condition. Immediate delivery. £550.

TIGER MOTH. C. of A. until Jan. 1957. Engine hours nil since new. Immediate delivery. £325.

AUSTER AUTOCRAT. C. of A. until April, 1957. Engine hours 130 since overhaul. New upholstery. Colour silver and red, recently resprayed. Immediate delivery. £925.

DETAILS of these and others in stock can be obtained from Mitchell Aircraft, Ltd., Airport, Portsmouth. Tel. 717641. [0348

VENDAIR of Croydon Airport

OFFER against payment in Sterling, the following American Aircraft.

PIPER TRI PACER, Cessna 140.

PIPER TRI PACER, Piper Apache (Twin Lycomings).

DETAILS from Vendair, Croydon 5777. [0603

AUSTER AUTOCRAT, three seats, privately owned. Full panel, navigation lights, aux. tank, new upholstery, C. of A. till December. Ivory-red finish. Inspection Elmdon. Parker, 64, Belvedere Road, Birmingham, 24. [5322

AIRFRAME spares for Dakota, Harvard, Piper Cub, Fairchild "Argus," Beechcraft D.17S, Mosquito, Spitfire, Firefly. Engine spares for Pratt & Whitney, Armstrong Siddeley, Lycomings, etc. Accessories and instruments for all types of aircraft.

A. J. WALTER, Gatwick Airport, Horley, Surrey. Tel. Horley 1420 and 1510 (Ext. 105/6). Cables Cubeng, London. [0268

AIRCRAFT ACCESSORIES AND ENGINES

80 NEW Inner Tubes 24 x 7.25. 12 packed in pairs. 5/- per pair. Box 2035. [5299

AUSTER AUTOCRAT and Rapide. X.P. propellers. Airviews, Ltd., Manchester Airport. Tel.: Gatley 5502. [5308

GIPSY MAJOR I engines for sale. Nil hours complete with log books. Only a few remaining.

MITCHELL AIRCRAFT, LTD., Airport, Portsmouth, Tel. 717641. [0349

FOR spare parts for Tiger Moths and Gipsy Major engines try Rollasons of Croydon Airport. The Tiger Moth and Gipsy Major engine specialists. Phone: CRO. 5151. [0131

FILAMENT Lamps, Landing and Cockpit Lamps, Generators, M1, O1, P1, 313, 314, Amplydyne, Inverters, etc. Super Cabin Heater, Relays, Fuses and a large range of other ancillaries, British and American.—Suplex Lamps, Ltd., 239 High Holborn, London, W.C.I. [0433

AIRCRAFT PROCUREMENT

GROUP CAPTAIN EDWARD MOLE, B.Sc., A.F.R.Ae.S., Aviation Consultant Specialist in the supply or disposal of all types of aircraft and aviation equipment. Quotations obtained upon request.—8 Brendon Street, London, W.1. Tel.: PADdington 5406. [0403

AIRCRAFT SERVICING

REPAIRS and C. of A. overhaul for all types of aircraft.—Brooklands Aviation, Ltd., Civil Repair Services, Sywell Aerodrome, Northampton. Tel.: Moulton 3218. [0307

BUSINESS OPPORTUNITIES

ADVERTISER has for sale full design and construction rights of modern two-seater light aeroplane of proved and excellent performance and handling characteristics. Proposition includes example of the type from first batch produced. Excellent opportunity for enterprising manufacturer. Demonstration available to principals. Write to Box 2210 *Flight*. [5319

CAPACITY AVAILABLE

KELLERING and profile milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5 ft. by 8 ft. max. size. We are die copiers to the trade.

ARMYTAGE BROS. (KNOTTINGLEY), LTD., The Foundry, Knottingley, Yorkshire. Tel.: Knottingley 2046. [0975

CLOTHING

R.A.F. officers' uniforms purchased; good selection of R.A.F. officers' kits for sale, new and reconditioned. Fishers, Service Outfitters, 86-88 Wellington Street, Woolwich. Tel.: Woolwich 1055. [0567

BKS

£500,000 of Viking Spares Actually in Stock

The following items are a small selection from our large stocks of Viking aircraft accessories and components.

BOLTS, CLAMPS, HINGES, BUSHES, etc.

Clamp	49853-447
Hinges	61027/113
Bush (Brake Bolt Hole)	40652-67
Bolt Elevator	49133-845
Bolt Aileron Rod	49133-849
Bolt Elevator Control Rod to link Shaft Levers	49133-851

VALVES, FILTERS, PIPES, etc.

Oil Fuel Elbows	61037-195
Filter Assembly	S.A.88 (E/30L/1/22537)
Filter Injector	S.A.86 (FB.152999)
Sump Oil Press. Regulator	S.A.70 (6J/1007)
Pipes	Various
Anti-Surge Valves	27H/FFA34
Hose, Flexible	26FL/Various

ELECTRICAL

Cover Commutator	N 23017 A
Clutch Pack	N 26121-3
Barrel Pinion and Stud Assembly	N 26485
Socket	CZ 50398
Fuse, 5-amp Large	5C/515
Switch Dimmer	5C/724
Resistance and Rectifier Unit	5C/1775

AIRCRAFT, GENERAL

Centre Section Spar Boom	61003 Sht11 (Mod. C1875)
Blocks, Jacking	49879-359
Ring Joint	Various
Control Rods	Various
Flexible Drive	49837-371
Sealing Ring	AHo18822/6
Rod Control Aileron	49133 Sht68
Fairlead	49133-73
Aileron Eye End Rod	49133-175
Rods, End Eye C/W Bearing	49133-781

All items A.R.B. Released.
Prices sent on request.

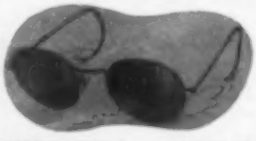
Sales Dept.
SOUTHEND AIRPORT
SOUTHEND-ON-SEA · ESSEX
Phone: Rochford 54496 Extn. 44. Cables: BEKAYESS, LONDON
Telex 99 7778

DERBY AVIATION LTD.
Aircraft and Engine Overhaul
Sales — Service — Tuition
Scheduled and Charter Operators
DERBY AIRPORT
Telephone: ET WALL 323

We are now able to accept contracts for the
MAINTENANCE AND REPAIR
of most
LIGHT AND MEDIUM TYPES
including
DAKOTAS · MARATHONS · VIKINGS
whilst our
LINK TRAINER SCHOOL
can undertake elementary and advanced courses at
ELSTREE AERODROME
ELSTREE · HERTS
Telephone: Elstree 3070

LONDON OFFICE: Telephone: ABBEY 2345
78, BUCKINGHAM GATE, S.W.1.

Latest Pattern **R.A.F. ANTI-GLARE SUN SPECTACLES** Complete with strong case.
22/6



GOGGLES
MK. VIII
25/-
Spare lenses available, tinted or clear. 7/6 pair.

FLYING HELMET No. 103. Serviceable helmet for club flyer. Ideal for those not requiring electrical intercom. Ear pkts. made to take Gosport tubes C/No. 214. Wt. 8 ozs. In brown only. Sizes 6¼" to 7½" **£1.13.0.** Gosport tube C/No. 214 **18/6.** Helmets complete with Gosport Tubes **30/-** per set.
FLYING SUITS. Fine serge-finished drill. Guaranteed shrink-proof. Front, legs and cuffs zip-fastened. Inverted pleat and saddle back. Large pkts. Detachable buttons. Cats.: White, navy, black. Sizes: 34-48. **84/-.**
★ *Terms to Flying Clubs. Trade supplied. Send 4d. in stamps for illustrated catalogue.*

Lewis LIMITED
(Dept. F.) 124 Gt. Portland Street, London, W.1.
Tel: Museum 4314. Grams. Aviakit, Wesdo, London

The . . .
British Air Line Pilots Association
95 MOUNT STREET, W.1
Tel.: GROsvenor 6261
Membership open to all Commercial and Service pilots. For full details concerning objects and particulars of Membership please write to Secretary.

A. G. ENGRAVING
292 EARLSFIELD RD., LONDON, S.W.18
Telephone: BATTERSEA 9097
★ *Engravers to well-known makers of Electronic Equipment used by the Aircraft Industry*
NAMEPLATES & SCALES OF EVERY DESCRIPTION IN ALL METALS AND PLASTICS

AIRCRAFT JACKS
WING AND PILLAR
All types available
Prices on application
Aero Maintenance Equipment Ltd.
100a Clapham Park Road, London, S.W.4
Telephone: MACaulay 2477/8

CLUBS

PLYMOUTH AND DISTRICT AERO CLUB for Auster and Tiger Moth flying instruction; dual and solo for £3 per hour reducing to less than £2 per hour for solo flying on "Fly Yourself Hire" basis; flying instructors' courses and M.C.A. approved courses for private pilot's licence.—Tel. Plymouth 72753. [0341

HERTS AND ESSEX AERO CLUB, Stapleford Tawney Aerodrome. M.C.A. approved private pilots' licence course. Auster, Gemini, Tiger, Hornet and Proctor aircraft. Trial lesson 35/-. 15 miles centre of London. Central Line Underground to Theydon Bois, bus 250 to club.. Open every day.—Tel.: Stapleford 210. [0230

CONTACT LENSES

MODERN CONTACT LENSES CENTRE, 7 (D.1), Endsleigh Court, W.C.1. Deferred Terms. Booklet sent. [0342

MISCELLANEOUS

RETRACTABLE ball point pens $13.50 gr., balloons 75 cents gr. up. Pocket combs 79 cents gr., hunting knives $5.25 dz., 3 in. steel scissors $3.50 gr., lipstick $4.50 gr., pocket knives $50 gr., 7 in. pencils $1.60 gr., ball pens 4 cents each, teaspoons $2.25 gr. up. Doll's $4.50 gr., nylon tooth brushes $3.50 gr. up. Cloth-hair-shoe brushes 10 cents each, clocks, watches. Men's ties 15 cents each. Needles, safety-pins, costume jewellery, etc. 6,000 closeouts 10 per cent below price. Toys, dolls, pearl necklaces 7 cents ea. Razor blades $1.50 per 1,000. Wallets 7 cents ea., compacts $4.50 doz. up. Perfumes, belts, scissors, etc. Also agents wanted. PAUL COHEN, CO., Inc., 881 B'way, NYC3. [0295

PUBLIC APPOINTMENTS

TECHNICIANS (Aeradio) Grade I required by EAST AFRICA High Commission Directorate of Civil Aviation on probation for pensionable employment. Salary scale (including inducement pay and present temporary allowance of 10 per cent) £772 rising to £1,122 a year. Outfit allowance £30. Free passages. Liberal leave on full salary after each tour 30/36 months. Candidates not over 38 years of age, should preferably possess C. and G. Certificate in Telecommunications Principles or Radio Part III or equiv. They must have had at least three years' experience in erection and maintenance of ground station transmitters, radio and radar navigational aids and aerial systems and should have up to date knowledge of workshop practice. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/41653/FE. [5309

SIERRA LEONE GOVERNMENT Posts and Telegraphs Department requires Signals Staff for two tours of 18/24 months each either (a) with prospect of pensionable employment or (b) on temporary terms with gratuity at rate £100/£150 a year. Salary scales (including Expatriation Pay) as indicated. Commencing salary according to qualifications and experience. Outfit allowance £60. Free passages for officer and wife. Free passages for two children under age 19 or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates should be experienced M.F., H.F., V.H.F., V.H.F./D.F. and ancillary equipment. Preference for C. and G. Certificate in Radio.

SIGNALS Officers (Aeradio) (M2C/41718/FE). Salary scale under terms (a) £1,272 rising to £1,442 a year or (b) £1,376 rising to £1,558 a year. Candidates should possess P.M.G. 1st Class Cert. or equiv. and should be able to control staff and organise traffic schedules.

ASSISTANT Signals Officer (Aeradio) (M2C/41719/FE). Salary scale under terms (a) £797 rising to £1,257 a year or (b) £859 rising to £1,359 a year. Candidates should possess P.M.G. Cert. or equiv.

WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote the reference number shown against the post applied for. [5311

CURD COMPONENTS LTD
41, LONSDALE ROAD, W.11—*Bayswater 0319*

MARSHALL
AIRPORT WORKS CAMBRIDGE
Required for 'on site' work
AIRCRAFT INSPECTORS
AIRFRAME FITTERS
AERO ELECTRICIANS
Modification and Repair Modern Jet Aircraft
Comfortable hostel accommodation (single or double cubicle) with good food whilst on familiarization at Cambridge.
Generous subsistence and other allowances 'on site.'
Send full particulars, experience, etc., and when available, to
EMPLOYMENT OFFICER

? DO YOU WISH TO EXPLOIT YOUR PRODUCTS IN ?
CANADA
YOUNG BUSINESSMAN VISITING U.K. IN JUNE WISHES TO NEGOTIATE RIGHTS TO SELL, ASSEMBLE or MANUFACTURE AS EXPEDIENT.
FIRST CLASS PRECISION ENGINEERING PREFERRED.
Send Full Details to Box 2066, c/o "Flight".

AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION S.P.47
CROSS MFG. CO. (1938) LTD., COMBE DOWN, BATH

Machinists of plastics for the Aircraft Industry
A.I.D. & A.R.B. APPROVED
Fairleads, Cleats, Panels, Knobs, etc.
E. S. ASTON & CO. LTD.
4 SEBASTIAN STREET
CLERKENWELL, LONDON, E.C.1
Telephone: CLERKENWELL 2179

COTTON BAGS
FOR SPARE PARTS, ETC.
WALTER H. FELTHAM & SON, LTD.
Imperial Works, Tower Bridge Road,
Telephone: HOP 1784 LONDON, S.E.1

A. V. ROE & CO. LIMITED

(AIRCRAFT CONSTRUCTORS)

GREENGATE, MIDDLETON, MANCHESTER

Have Vacancies on Super-Priority Design and Development Projects for

DESIGN DRAUGHTSMEN

(Senior and Junior)

Applications are invited from individuals having Aircraft, Mechanical, Structural or Electrical experience.

Salaries will be arranged according to experience and ability.

Applications will be treated in strict confidence and should be addressed, in the first place, quoting Ref. PM/1 to:

Personnel Manager, A. V. Roe & Co., Limited, Greengate, Middleton, Manchester

SAUNDERS-ROE LIMITED

require

Senior, Intermediate and Junior

DRAUGHTSMEN
STRESS ENGINEERS
AERODYNAMICISTS

and other Technicians at their London, Eastleigh and Osborne, I.o.W. design offices.

Applications will be welcomed from experienced technicians who are keen to join an expanding organisation engaged on interesting and advanced projects of an important nature.

Conditions are good and assistance with accommodation can be given to those selected to work at Osborne.

Interviews may be arranged in London and in other centres.

Please send brief particulars (quoting ref. F/72) to the **Personnel Officer, Saunders-Roe Limited, East Cowes, I.o.W.**

The ENGLISH ELECTRIC CO. LTD.
GUIDED WEAPONS DIVISION LUTON

have vacancies for a

STRESSMAN

and a

DESIGN DRAUGHTSMAN

with degree or H.N.C.

to assist in the study of new Guided Weapon projects; some experience of aircraft or missile stressing would be preferred for the former vacancy.

Applications, in strict confidence, to: Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. 699A.

PUBLIC APPOINTMENTS

PILOT required by Nigerian Federal Government on contract for 12/24 months in first instance. Salary scale (including inducement addition) £1,608 rising to £1,824 a year. Commencing salary according to experience. Gratuity at rate £150 a year. outfit allowance up to £60. Free passage for officer and wife. Assistance towards cost of children's passages and grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates preferably aged 25-40, must possess a C.P.L., Instrument Rating and Radio Telephony Licence, with at least 1,000 hrs. as pilot-in-charge of single and twin-engined aircraft. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in black letters, full qualifications and experience and quote M3B/42728/FE. [5312

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 790. From Lancashire Aircraft Corporation, Ltd., of 7, Berkeley Street, London, W.1, for a U.K. Internal Service with Dakota and D.H.89 aircraft for the carriage of passengers, supplementary freight and mail between Blackpool (Squires Gate) and Belfast (Nutts Corner) at a frequency in accordance with demand for a period of seven years, commencing September 1, 1956.

FROM Air Kruise, Ltd., of 1, Great Cumberland Place, London, W.1:—

APPLICATION No. 213/1 (Amended) for amendments to the terms of approval of the Internal Service which they are authorised to operate during the period up to September 30, 1960, on the route Ramsgate and/or Lydd-Birmingham (Elmdon), so as to operate instead on the route Ramsgate and/or Lydd-Birmingham (Elmdon) and/or Manchester (Ringway) and/or Liverpool (Speke) and to use Bristol 170 aircraft in addition to the aircraft types already approved.

APPLICATION No. 793. For a Normal Scheduled Service with Bristol 170 or Dakota aircraft and later possibly with Handley Page Herald aircraft for the carriage of passengers, supplementary freight and mail between Lydd and Lyons at a frequency of up to seven return flights weekly for a period of 10 years commencing from date of approval.

APPLICATION No. 791. From Eagle Aviation Ltd., of Marble Arch House, 32-50, Edgware Road, London, W.2, for a Seasonal Inclusive Tour Service with Viking and Dakota aircraft in conjunction with Sir Henry Lunn, Ltd., for the carriage of passengers and supplementary freight between London (Blackbushe) and Rome (Ciampino) at a frequency of up to seven return flights weekly during the season from May to October inclusive each year, for a period of seven years, commencing May 1, 1957.

APPLICATION No. 440/1. From Air Charter, Ltd., of 15, Great Cumberland Place, London, W.1, for an amendment to the terms of approval of the Vehicle Ferry Service which they are authorised to operate during the period up to July 7, 1962, on the route Southend-Rotterdam and/or Ypenburg, so as to increase the frequency to two return flights daily and for permission to carry up to 12 passengers not associated with vehicles per flight instead of six such passengers as at present authorised.

APPLICATION No. 792. From Skyways, Ltd., of 7, Berkeley Street, London, W.1, for a Normal Scheduled Service with Dakota aircraft for the carriage of passengers, supplementary freight and mail between Lympne on the one hand and Vichy and/or Valence and/or Lyons (Bron) on the other, at a frequency of up to ten return flights daily for a period of 10 years from March 1, 1957.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5320

PACKING AND SHIPPING

R. and J. PARK, Ltd., 153-8 Fenchurch St., E.C. Tel.: Mansion House 3083. Official packers and shippers to the aircraft industry. [0012

PATENTS

THE proprietor of British Patent No. 650,322 for "Improvements in Folding Wings for Aircraft," desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from Marks & Clerk, 57 and 58, Lincoln's Inn Fields, London, W.C.2. [5315

HUNTING PERCIVAL AIRCRAFT LIMITED

require the following staff immediately in the Main Office at Luton:

SENIOR AND INTERMEDIATE DESIGN DRAUGHTSMEN

Vacancies exist in all branches of airframe design. Applicants should have several years' basic design experience and preferably have obtained O.N.C. or H.N.C.

SENIOR AND INTERMEDIATE ELECTRICAL DRAUGHTSMEN

Good general knowledge of electrical equipment and its installation essential, previous aircraft experience, plus O.N.C. or H.N.C. desirable.

LOFTSMEN

Previous experience in full-scale layout work preferable, but applicants with good background in an allied trade would be considered for training.

STANDARDISATION DRAUGHTSMAN

Senior Draughtsman required to undertake all aspects of this work. Applicants should possess wide drawing office experience and have a knowledge of production office methods.

Contributory pension and life assurance scheme.

Good salaries and promotion prospects. Holiday arrangements for current year will be honoured.

Applications, giving full details of experience, qualifications, age and salary required, and quoting Ref. MF, should be forwarded to the Personnel Manager.

HUNTING PERCIVAL AIRCRAFT LIMITED, LUTON AIRPORT, BEDS.

AIR CHARTER LIMITED

require for their long range Tudor fleet:

(a)

FLIGHT RADIO OFFICERS

Minimum qualification M.T.C.A. temporary licence.

(b)

FLIGHT NAVIGATORS

Minimum qualification M.T.C.A. F/N's technical licence.

(c)

FLIGHT ENGINEERS

Minimum qualification F/E's basic M.T.C.A. examination for the "O" licence.

Apply by letter in first instance, giving full particulars to:

Operations Manager, AIR CHARTER LIMITED, 15, Great Cumberland Place, W.1

PERSONAL

GREEN. On 18th May, 1956, at Mtarfa, Malta, G.C., to Betsy Anne, wife of Wing Commander H. M. S. Green, R.A.F., a daughter. [5317

TUITION

AIR SERVICE TRAINING

The only fully equipped private School of Aviation. Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensure the soundest training for an aviation career.

M.T.C.A. APPROVED COURSES

for private and commercial pilots' licences and maintenance engineers' licences in categories "A" and "C." Advanced courses for pilots, navigators, radio officers and engineers.

HELICOPTER COURSES

for private and professional licences. Details available from the Commandant.

AIR SERVICE TRAINING, LTD.,
Hamble, Southampton. Tel. Hamble 3001/9.
[0970

LEARN to fly, £26; Instructors' Licences and Instrument flying for £3/5/- per hour. Night Flying £4/5/- per hour. Residence 6 guineas weekly. Approved M.C.A. Private Pilots' Licence course. Specialised course for Junior Commercial Pilots' Licence.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome (Andover Junction 1 hour 15 minutes from Waterloo), Hants. [0253

LINK Trainer courses to Instrument Rating standard. Also practical instrument flying, twin-engine conversions, instructors' courses and all forms of advanced training for prospective professional pilots. Phone Elstree 3070 or write Chief Instructor, Elstree Aerodrome, Herts. [5187

TUITION

MINISTRY APPROVED COURSES
for the
COMMERCIAL PILOT AND INSTRUMENT RATING
at the
LONDON SCHOOL OF AIR NAVIGATION

ALL subjects for professional pilot or navigator licences and ratings embracing Academic, Technical, Simulated and Flying aspects. Full-time personal coaching, also short periods. Home-study excellent alternative.
33 OVINGTON SQ., KNIGHTSBRIDGE, LONDON, S.W.1. KEN. 8221.
FLYING BASE: CROYDON AIRPORT. [0277

CIVIL PILOT/NAVIGATOR LICENCES

Contact the Principal for details of Classroom and Postal Tuition at:

AVIGATION LIMITED

30 Central Chambers, Ealing B'way, London, W.5. Phone: Ealing 8949. [0249

SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

SOUTHEND-ON-SEA Municipal Air Centre and Flying School. Comprehensive flying training for all pilots' licences, ratings and endorsements. Special facilities for instruments, night-flying and commercial pilot licences. No entrance fee or subscriptions. MUNICIPAL Airport, Southend-on-Sea, Essex. Rochford 56204. [0453

FREE: Brochure giving details of courses in all branches aero eng., covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F.26, London, W.4. (Associated with H.M.V.) [0964

TUITION

A.F.R.Ae.S., A.R.B. Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms. Over 95 per cent successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., etc. Write for 144-page handbook free.—B.I.E.T. (Dept. 702), 10 Wright's Lane, London, W.8. [0707

SITUATIONS VACANT

EDGAR PERCIVAL AIRCRAFT, LTD.
require
SENIOR STRESSMEN AND DRAUGHTSMEN
For an important role in our Design Team.
Vacancies also exist for
Intermediate and Junior
STRESSMEN AND DRAUGHTSMEN
Group Flying Scheme. Pension Scheme.
Apply (strictest confidence assured).

CHIEF DESIGNER: Edgar Percival Aircraft, Ltd., Stapleford Aerodrome, Abridge, Essex. Tel.: Theydon Bois 2321. [5325

FERRANTI LIMITED, Edinburgh, have vacancies with their Turnhouse Flying Unit for Air-Frame Fitters (R.A.F. trade Fitter 2A). Experience of detailed fitting and jet aircraft essential. Apply giving full particulars to the Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh, 5, quoting Ref. T.I.D./29. [5314

SENIOR qualified development engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with Servo systems, small precision motors and gyroscopic control systems. Apply stating age, qualifications, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146

PYE LIMITED
OF CAMBRIDGE

require the following staff for their

GUIDED MISSILE PROJECT

1. One senior mechanical design draughtsman with H.N.C.
2. Two design draughtsmen with O.N.C.
3. One electronic engineer with O.N.C.
4. One computor (female) with B.Sc.Maths (applied) or Physics.
5. One experimental fitter model maker.

Applications, giving brief personal details, which will be treated in strict confidence, should be addressed to

Chief Engineer,
Pye Limited, St. Andrew's Road, Cambridge, quoting 'GMP'.

MARSHALL
AIRPORT WORKS CAMBRIDGE

Skilled men required at Cambridge Airport

AIRFRAME FITTERS
AERO ELECTRICIANS
SHEET METAL WORKERS

Programme includes Development Work, Trial Installation and Modification on

MULTI-JET AND TURBO-PROP AIRCRAFT

Single lodgings available on Housing Estates near Works.

Write, call or phone
Cambridge 56291 Ext. 36.
Employment Officer.

VICKERS-ARMSTRONGS (AIRCRAFT)
LIMITED
WEYBRIDGE, SURREY

have a vacancy for a

FIRST-CLASS AIR CONDITIONING DESIGN ENGINEER

to be responsible for Aircraft Pressurizing, Ventilating and Refrigerating Systems.

The post is of

SENIOR EXECUTIVE STATUS

with excellent prospects of advancement.

VICKERS-ARMSTRONGS (AIRCRAFT) LTD.

also have a vacancy with good prospects of advancement for a

FIRST-CLASS HYDRAULICS DESIGN ENGINEER

for Aircraft Systems.

Applications should be addressed to:

The Chief Designer,
Vickers-Armstrongs (Aircraft) Ltd.,
Weybridge, Surrey.

SITUATIONS VACANT

IMPERIAL CHEMICAL INDUSTRIES LIMITED

METALS DIVISION

APPLICATIONS are invited for several senior positions as:

PROJECT OFFICERS

in the

TECHNICAL DEPARTMENT,

Located at Witton, Birmingham

Duties will entail the consideration of both the technical and commercial aspects of proposals to provide new or improved facilities for the melting, casting and preliminary fabrication of wrought non-ferrous products, including titanium. This will involve an appreciation and keen interest in the activities of other departments, i.e., Research, Engineering, Production, Accountancy and Sales. These liaison duties will enable the successful candidates to acquire a comprehensive experience of industrial activities in general.

Applicants, between the ages of 28 and 40, should possess an Honours Degree in Physics,, Metallurgy, Engineering or Mathematics. Experience in industry is essential but appropriate further training, if necessary will be arranged.

These positions offer most attractive salary prospects and will only be offered to men of outstanding ability.

Excellent conditions of employment include a contributory Staff Pension Fund and a Profit Sharing Scheme. After joining the staff, married men will receive a reasonable refund of removal (including travel) expenses, and to assist them in house purchase, facilities are available, in approved cases, for loans.

Applications, giving brief details of career to date, should be addressed to the Staff Manager, I.C.I. Metals Division, Kynoch Works, Witton, Birmingham, 6, quoting TD/1/F. [5295

SITUATIONS VACANT

SKYWAYS LIMITED

require the following categories of air crew:

1. Captain. Must be in possession of A.L.T.P. preferably with Group 1 endorsement for Hermes and/or York aircraft, and should have had experience on modern 4-engined aircraft. Salary in scale £1,545/£1,745 per annum.

First Officers. Minimum qualification commercial pilot's licence with instrument rating, preferably endorsed for York and/or Hermes aircraft. Applicants should be experienced on modern 4-engined aircraft. Salary in scale £1,205/£1,475 per annum.

Radio Officers. Applicants must hold M.T.C.A. 1st Class flight radio operator's licence. Salary in scale £885/£1,340 per annum.

Engineer Officers. Preference given to applicants with basic "O" licence with Hermes type rating. Possession of A.R.B. "A" and/or "C" licences covering Hermes aircraft and Hercules engines an advantage. Salary whilst under training £700 per annum. Minimum commencing salary after training £855 per annum.

ALL above grades will be based at Stansted Airport, Essex.

2. Captains with A.L.P.T. endorsed in Group 1 for Dakota aircraft. Salary in scale £1,410/£1,610 per annum.

First Officers with minimum qualification of commercial pilot's licence and instrument rating, preferably with Dakota endorsement. Salary in scale £1,110/£1,380 per annum.

THESE vacancies are at Lympne and Squires Gate Airports.

Apply with full details to Personnel Manager, Skyways, Limited, Stansted Airport, Stansted, Essex. [5318

GERMANY: A vacancy exists for a "C" licensed engineer on Viking aircraft based at Frankfurt/Main. Good salary and generous overseas allowance paid. Apply to Airwork Limited, D.F.G., 35 Piccadilly, London, W.1. [5307

SITUATIONS VACANT

CANADA

CANADIAN AVIATION ELECTRONICS, LTD.

Montreal, Quebec,

requires

ELECTRO-MECHANICAL

and

ELECTRONIC ENGINEERS

GENERAL qualifications: British born subjects with University degree or H.N.C. Electro-mechanical engineers with experience in design of automatic control systems or analogue computers.

ELECTRONIC engineers with experience in design of electronic systems employing special circuits, e.g. Radar, TV receivers and TV monitoring equipment. Some familiarity with analogue computing circuit techniques desirable, but not mandatory.

ASSISTED passages. Employee benefits include Hospitalization insurance, sick leave pay, life insurance and pension plans. Interviews in London, Farnborough, Wells, Malvern, Coventry, and Manchester during June.

SEND detailed application to

Mr. Brian Stevens,

c/o Canadian Department of Labour Representative,

61 Green St., London, W.1. [5316

CHIEF GROUND ENGINEER AND FLIGHT ENGINEER

for

OIL COMPANY SUMATRA

APPLICATIONS are invited for the following positions:

(a) Chief Ground Engineer with current "A" and "C" flight licences and "X" ground licence preferably not over 40 with five or more years experience as inspector on aircraft and engine maintenance and conversant wih C. of A. requirements for Dakota and DC 3 aircraft with P. & W. twin Wasp R 1820-92 engines. Commencing salary £194 per month.

(b) Flight Engineer with current "A" and "C" flight licences for same aircraft and engines preferably not over 40 and with three or more years experience. Commencing salary £149 per month.

IN addition to salary an allowance is given which covers board and lodging and paid home and local leaves are granted with participation in a pension plan and free medical attention. Apply with full particulars quoting "SUM" to Caltex Services Limited, Thames House South, Millbank, London, S.W.1. [5313

REQUIRED BY DAN-AIR ENGINEERING, LTD.

CHIEF INSPECTOR

FULLY CONVERSANT WITH YORK AND DAKOTA AIRCRAFT AND A.R.B. PROCEDURE.

APPLY to:

Chief Engineer,
Hangar Building No. 83,
Lasham Airfield,
nr. Alton,
Hampshire. [5248

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

HAVE vacancies for a number of Draughtsmen for interesting work on supersonic wind tunnel equipment and model design. Excellent working conditions are provided, the salaries are good and the work is of a permanent character.

All replies should be addressed to:
Technical Appointments Officer,
Sir W. G. Armstrong Whitworth Aircraft, Ltd.,
Baginton, Nr. Coventry.
Please quote reference: WT 3 ARM/TAO. [5313

INSTRUMENT DRAUGHTSMEN

VACANCIES exist at Woodford Aerodrome for new and interesting work on Guided Weapons. Experience of small electrical or electronic design, or alternatively electro mechanical instrument design is necessary. Very good working conditions are provided, and attractive salaries will be paid to suitably qualified personnel. Applications stating experience, technical qualifications, present salary and salary required, should be addressed to the Personnel Manager, A. V. Roe & Co., Limited, Greengate, Middleton, Manchester. [5288

LICENSED Aircraft Engineer required to take charge of small workshop engaged in overhaul and maintenance of Aero Club fleet and overhaul to C. of A. standards of all types of light aircraft. An Assistant Licensed Engineer is also required. Apply Mitchell Aircraft, Ltd., Airport, Portsmouth, Hants. [0351

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER

(Member of the Hawker Siddeley Group)

OFFERS YOU AN OPPORTUNITY TO BUILD A REWARDING AND SUCCESSFUL CAREER WITH BRITAIN'S MOST PROGRESSIVE AIRCRAFT COMPANY

Vacancies exist on super-priority work for

DRAUGHTSMEN

on

PROJECT DEVELOPMENT

and

AIRCRAFT DESIGN

(Experienced Structural, Electrical and Mechanical Draughtsmen also required. Aircraft experience not essential)

AERODYNAMICISTS

(Of some years' experience. Fluent mathematical ability essential)

STRESSMEN

(For both strength and flutter calculations)

WEIGHT ENGINEERS

(Senior and Junior. To assist in the control of weights during design and development. Previous experience essential)

These appointments are of a progressive and permanent nature, with commencing salaries based on qualifications and experience

Our large modern factory is situated in the Cotswold Hills, with excellent canteen, sports and welfare facilities, hostel accommodation available and assistance given with housing and with removal expenses

Applications stating age, previous employers and experience, etc., should be addressed to the **CHIEF DESIGNER**

SITUATIONS VACANT

THE Supermarine Works of Vickers-Armstrongs (Aircraft) Limited, have vacancies for:—

SYSTEMS ENGINEERS

in the electrical, hydraulic and air-conditioning sections of their design offices. Previous experience not essential.

Apply Personnel Department, South Marston Works, Nr. Swindon, Wilts, or at Hursley Park, Nr. Winchester, Hants. [5262

APPLICATIONS are invited to fill following vacancies in helicopter unit operating Westland S.55s.

1. First Officer.
2. Radio Engineer, preferably licensed.
3. Fitter.

TERMS include good salary, two months' holiday each summer and service with Antarctic whaling factory expeditions, departing each year October, returning April/May. Preference given to personnel with previous helicopter experience. Applications with full particulars to Chr. Calvesen & Co., 29 Bernard Street, Leith. [5323

ARMSTRONG SIDDELEY MOTORS, Coventry require the following staff for work on Air Publications dealing with gas turbine aero engines:

TECHNICAL Writers. Practical engineering experience, technical knowledge, and at least 2 years' experience in technical authorship are essential.

TRAINEE Technical Writers. Engineers with R.A.F. or F.A.A. experience and a genuine interest in beginning a career in technical authorship are offered training in the art of writing. Ability in simple English composition is essential

TECHNICAL Illustrators. Several years' experience in preparing sectioned perspective and exploded perspective drawings, for letterpress and lithographic reproduction, from engineering drawings. Ability to prepare line-and-colour diagrams to the requirements of Technical Writers. Wash and air brush experience and knowledge of reproduction processes is desirable.

SPARE Parts Schedule Compilers. Ability to prepare spare parts schedules from general arrangement and detail drawings. Experience of Air Ministry D.I.S. and Mod. procedure would be an asset.

APPLY giving fullest details of age, experience and present salary to Personnel Manager, quoting Reference W/1. [0465

DRAUGHTSWOMEN required by Aircraft Equipment Company in South Bucks. Salary according to age and experience, up to £13 per week. Apply to Box No. 1775. [0475

MARSHALL

AIRPORT WORKS CAMBRIDGE

Aircraft Inspectors

required

Airframe and Electrical

Applications for these vacancies can only be considered from those with recent experience on Multi-Jet and Turbo-Prop Aircraft.

(Repair, Trial Installation and Conversion)

Suitably qualified applicants will be offered

Staff Rates and Conditions
Including Contributory
Superannuation
Plus Housing Assistance if Required

Comfortable Hostel accommodation available for initial probationary period, or if preferred private lodgings near works can be arranged.

Written applications giving full particulars of experience, etc., should be addressed to

EMPLOYMENT OFFICER

BROOKLANDS AVIATION LTD.

NORTHAMPTON

require

SENIOR INSPECTORS

for work on

VALETTA and VARSITY AIRCRAFT

Regular work and Overtime

APPLY TO:

BROOKLANDS AVIATION LTD.

Buttocks Booth, Moulton, Northampton

HUNTING-CLAN

AIR TRANSPORT LIMITED

require

FLIGHT RADIO OFFICERS

for their VIKING and YORK fleets

Minimum qualifications are

FIRST CLASS
FLIGHT RADIO OPERATOR'S LICENCE
as issued by M.T.C.A.

Reply:

BASE MANAGER
HUNTING-CLAN AIR TRANSPORT LTD.
London Airport, Hounslow, Middlesex

SIR W. G. ARMSTRONG-WHITWORTH AIRCRAFT LTD.

ARMAMENTS DIVISION

SENIOR ELECTRONIC AND ELECTRICAL ENGINEERS

A number of Senior Engineers, both Electronic and Electrical, are required for work associated with the flight trials of guided weapons.

The work is of a very varied and interesting character, and includes system testing and the analysis of the behaviour of complex installations including mechanical and hydraulic components, in addition to electronic and electrical components.

A number of years' experience in electronic and/or electrical engineering is essential for these positions, and service experience of radar, radio and telecommunications is a very suitable qualification.

A university degree is not essential for these positions but practical experience and experience of experimental work is highly desirable.

The positions are responsible posts and carry attractive salaries and excellent prospects.

Pleasant working conditions and amenities are provided and an attractive superannuation scheme is in operation.

All replies should be addressed to:—

Technical Appointments Officer,

SIR W. G. ARMSTRONG-WHITWORTH AIRCRAFT LTD.,

BAGINTON, NR. COVENTRY, quoting Reference FT/5/ARM/TAO.

GUIDED MISSILES

A Senior Engineer is required by an important Company, engaged on major guided missile projects, to take charge of work associated with the flight trials of these weapons.

The main responsibilities of this post are to co-ordinate the work of a large group of technicians engaged on this task; the work is of a very interesting and varied character, and covers overall system testing and the analysis and the behaviour of installations covering mechanical, hydraulic, electronic and electrical engineering.

A University Degree or its equivalent is required in one of the following branches of engineering:—

Servo-control systems, Electronic and Electrical Engineering, Radar, radio and telecommunications.

The salary scale will be commensurate with the high degree of responsibility associated with this Senior post, and the successful applicant will be eligible for the Company's attractive Superannuation Scheme.

All replies should be addressed to:—

Box No. 2170, c/o "Flight," quoting Reference L/3.

HUNTING PERCIVAL AIRCRAFT LIMITED

have immediate vacancies in their London Design Offices for

EXPERIENCED AIRCRAFT STRESSMEN
(holding H.N.C. or equivalent)

SENIOR AND INTERMEDIATE DRAUGHTSMEN
(preferably with aircraft experience)

The Offices, at 18 Cavendish Square, W.1, are centrally situated and afford very comfortable working conditions.

The positions are permanent with good promotion prospects.

Contributory PENSION and Life Assurance Scheme is in operation.

Existing holiday arrangements will be honoured.

Special AIR TRAVEL facilities with an Associated Company are available.

Please apply, in the first instance, giving full particulars of age, experience, qualifications and salary required to:

The Personnel Manager, Hunting Percival Aircraft Limited, Luton Airport, Bedfordshire.

AVRO

A. V. ROE & CO. LIMITED

The following senior vacancies exist in the AVRO design team for work on the design and development of supersonic aircraft:

AIRCRAFT ELECTRICAL ENGINEER
The applicant must have experience of the aircraft electrical field both on design and installation. Should have a thorough knowledge of basic principles of A.C. systems.

FLIGHT TEST AERODYNAMICIST
The applicant must have experience of flight test work including performance, stability and control, etc.

CONTROL SYSTEMS ENGINEER
The applicant must have theoretical and practical experience of servo mechanisms, and preferably a knowledge of missile or aircraft control systems.

Applicants possessing the required level of experience and ability will find that the salaries, opportunities and working conditions offered are exceptional.

If you think you can fill one of these positions, please write to the CHIEF DESIGNER, A. V. ROE & CO. LTD., GREENGATE, MANCHESTER, giving particulars of your qualifications and experience.

SITUATIONS VACANT

A. and C. licensed engineers wanted covering Auster Aiglets and other light aircraft. Boardsides Aircraft Servicing, Ltd., Boston, Lincs. [5256

WANTED. Works Manager. Preferably licensed. Electrical and ancillary overhaul workshops. Full details. House available. Surrey. Box 2113. [0976

CAPTAIN required with senior commercial or A.L.T.P. licence. Dakota endorsement an advantage. Reply to Chief Pilot, Cambrian Airways, Ltd., Rhoose Airport, Barry, Glam. [5287

WANTED Q.F.I./Staff Pilot for Meteor, Attacker and Sea Venom aircraft. Apply Chief Pilot, Airwork Limited, Royal Naval Air Station, St. Davids, Nr. Haverfordwest, Pembs. [5285

TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

EAGLE AIRCRAFT SERVICES, LTD., require the following personnel: Inspectors, preferably with "A" and "C" licences on Viking and Dakota. Storekeeper (with aircraft experience).

SKILLED airframe fitters. Skilled engine fitters. Skilled instrument fitter. Planning engineer. Licensed radio engineer (aircraft). Skilled hydraulic fitter.

APPLY Personnel Officer, Personnel Department. Telephone Yateley 2371. [5324

AIRCRAFT section leader design draughtsman required. Salary according to age, experience and qualifications up to £900 per annum. Pension scheme/superannuation fund in operation. Write or phone: BAYNES AIRCRAFT INTERIORS LIMITED, Langley Aerodrome, Bucks. Telephone: Langley 451. [0476

TECHNICAL Representative. In connection with well-known riveting process used in all trades. Write giving details of age, experience and salary required to Box V957, c/o Streets, 110, Old Broad Street, E.C.2. [5310

JUNIOR Detail Draughtsman required for Aircraft Component Development. Aircraft experience preferred but not essential. Reply in writing to: King Aircraft Corporation, Fifth Street, Montrose Ave., Hillington, Glasgow, S.W.2. [0421

SALES Manager or Chief of Sales. Widely experienced man with world wide contacts in aircraft sales. Excellent opportunity for right person. Reply full details: Edgar Percival Aircraft, Ltd., Stapleford Aerodrome, Romford, Essex. [5311

SENIOR Design Draughtsman, accustomed to working with the minimum of supervision, required for Aircraft Component Department. Aircraft experience preferable but not essential. Salary in accordance with experience and qualifications. Reply in writing to: King Aircraft Corporation, Fifth Street, Montrose Ave., Hillington, Glasgow, S.W.2. [0420

ARMSTRONG SIDDELEY MOTORS urgently require experienced checkers and weight estimators in their aero engine drawing office. Good salaries commensurate with age and experience, also superannuation and insurance scheme. Applications giving full details to Reference Check/2, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [0461

WELL established small aircraft firm in Midlands wishes to obtain designer in charge of new drawing office. Candidates, who must be over 30 years old, must have a wide experience in aircraft structures and in mechanical design. Applicants must have a degree or Higher National Certificate in Engineering or an equivalent qualification. Further prospects are good for the right man, who must show initiative and good judgment. Box 2104. [5314

ASSISTANT Cost Accountant required for large aircraft company, situated West of London. Experience in aircraft costing preferable but not essential likewise experience of punched card accounting. This pensionable position offers excellent prospects to a young man aged 25-35 years who has qualified for or is studying for A.C.W.A. Please send details of experience to Box MK7516, A. K. Advg., 212a, Shaftesbury Avenue, London, W.C.2, under reference J17. [5308

ARMSTRONG SIDDELEY MOTORS invite applications from Junior and Senior Mechanical Designers and Technical Assistants to join their project design team for work on aircraft gas turbines and a variety of other fascinating problems associated with supersonic flight. This is an exceptional opportunity for the above average designer accustomed to higher class work and with a flair for inventiveness, originality and responsibility, to gain experience and knowledge in pleasant surroundings. Very attractive salaries will be paid for experience. Application quoting Reference SR/DA to Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [0464

WEST AFRICAN AIRWAYS CORPORATION who operate services in and between Nigeria, Gold Coast, Sierra Leone, Gambia, and Dakar, invite applications from pilots with the following qualifications: Commercial Pilot's licence, with or without instrument rating, or Senior Commercial Pilot's licence. Salary, according to previous experience and qualifications, in the range of £1,270 to £1,340 per annum, plus an expatriation allowance of £300 per annum; car and domestic allowance of £144 per annum is also payable. Free fully furnished quarters, free passages for officer, wife and up to two children. Leave at the rate of one-fifth of overseas tour approximately every fifteen months. There is a contributory pension scheme in force. Applications (to be marked "Pilot") to be addressed to the European Representative, West African Airways Corporation, 29 New Bond Street, London, W.1. [5303

THE HESTON AIRCRAFT CO. LTD.

HESTON AIRPORT
Hounslow, Middlesex

have immediate openings in their

DESIGN OFFICE

on a new and interesting Civil Aeroplane for:

SENIOR, INTERMEDIATE and JUNIOR DRAUGHTSMEN, EXPERIENCED STRESSMEN, LOFTSMEN

LONG-TERM PROGRAMME
Good opportunities

Please write with full particulars to:
THE CHIEF DESIGNER

BAYNES
AIRCRAFT INTERIORS LTD.

have vacancies for

STRESSMEN | **DRAUGHTSMEN**
WEIGHTSMEN | **LOFTSMEN**

For super-priority work in connection with the design and manufacture of luxurious furnishing and equipment for world's leading airliners.

★ **Good Working Conditions**
★ **Canteen and Club Facilities**
★ **Pension and Life Assurance**
★ **Assistance with Housing**

Excellent prospects for keen men preferably with experience in all or any of the following:—

Fuselage and Cabin Structures, Passenger and Crew Seats, Pantries, Dressing Rooms, Lavatories, Water Systems, Tanks and Drainage, Electrical Systems, Air Conditioning and Ducting, Fuel Systems and Tanks, Freighter Conversions, etc.

Apply to: **THE PERSONNEL OFFICER**
BAYNES AIRCRAFT INTERIORS LTD.
LANGLEY AERODROME, BUCKS

SITUATIONS VACANT

WANTED. Licensed Chief Inspector. Experienced Dakota and ancillaries. House available. Surrey. Box 2114. [0977

WANTED immediately, Senior and Intermediate Draughtsmen for work on an interesting Aircraft programme. Good salaries and conditions, apply in writing with details of previous experience to: King Aircraft Corporation, Hillington, Glasgow, S.W.2. [0423

SENIOR Aircraft Stress Engineers are required by a South of England Aircraft Company. Applicants must have a minimum of 6 years' experience. Salaries £900 to £1,100 per annum according to experience. New Houses to rent will be offered to those appointed. Good employment conditions and a Superannuation and Life Assurance Scheme is in operation. Please send full particulars of experience to Box A.C.15974, Samson Clarks, 57-61 Mortimer Street, London, W.1. [0280

AIRCRAFT Jig and Tool Draughtsmen. Senior and intermediate men with aircraft experience are required in the Isle of Wight. Unfurnished accommodation will be offered to selected applicants and a staff assurance scheme and pension fund is in operation. Write, giving details of age, experience and salary expected, to the Personnel Office, Saunders-Roe, Limited, East Cowes, Isle of Wight. [5321

DEVELOPMENT Engineers and Physicists are required for work in the new and rapidly expanding laboratories of Louis Newmark, Ltd., at New Addington, Surrey. The work includes the design and development of instruments and equipment for the aircraft and allied industries, and some working experience of small electromagnetic instruments is desirable. Good salary based on age and experience. Pension scheme. Apply in writing giving full particulars to: Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon. 5328

CHIEF Inspector urgently required, fully experienced man in all branches of complete aircraft construction, should hold A.R.B. and/or A.I.D. approval, works situated in London area. Box No. [5312

AERO Engine Control System Engineers are required for a newly formed department dealing with various theoretical aspects of aero engine control problems. Experience of servo mechanism analysis and gas turbine engine performance investigation is desirable. Applications quoting END to Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [0470

WANTED, Draughtsmen to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to Northern Aluminium Co., Ltd., Bush House, Aldwych, London, W.2. [0348

STRESSMEN

A number of Stressmen are required for interesting work in the Guided Weapons Division of Sir W. G. Armstrong Whitworth Aircraft Ltd.

The minimum qualifications are H.N.C. in Mechanical, Aircraft or Structural Engineering, together with at least two years' experience in the stress office of an Aircraft or Guided Weapons organisation.

Pleasant working conditions and amenities are provided and an attractive superannuation scheme is in operation. The work is of a permanent character in a new and expanding field, and the salaries are good.

All replies should be addressed to:—

Technical Appointments Officer,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
BAGINTON, NR. COVENTRY, quoting Reference St/5/ARM/TAO.

SITUATIONS WANTED

PILOT, C.P.L., 1,900 hours, i/c 1,600. Singles and Twins, part time or temporary considered. South or South-East. Box 2244. [5327

YOUNG man (25), well educated, N.S. Officer (army), seeks position enterprising concern connection aviation. Technical knowledge and aptitude but anything considered; salary unimportant. Work 24 hour day for right opening. Box 2243. [5326

BOOKS, ETC.

FOR Sale, Jane's "All the World's Aircraft," 1919; good condition. £35. Gordon A. Storey, 9, Cecil Court, London, W.C.2. [5306

BAYNES AIRCRAFT INTERIORS LIMITED

require

STRESSMEN AND WEIGHTS ENGINEERS

for varied and interesting work on civil airliners.

Pension and Life Assurance Scheme.

Interviews can be arranged for Saturdays or evenings if necessary.

Apply, stating experience and salary required, to:

The Personnel Officer,
Langley Airport, Bucks

A. V. ROE & COMPANY, LIMITED

HAVE ONE OR TWO VACANCIES

FOR

DESIGN & DEVELOPMENT DRAUGHTSMEN

to work on Guided Weapons at Woodford Aerodrome, Cheshire.
Applicants should be experienced Aircraft Draughtsmen.

This is an excellent opportunity to join an expanding organization. Attractive salaries will be paid to suitably qualified personnel. Working conditions are exceptional.

Written applications, which will be treated in confidence, should be addressed, quoting Ref. WRD/DD, to:

The Personnel Manager, A. V. Roe & Co., Ltd., Greengate, Middleton, Manchester.

INDEX TO ADVERTISERS

	Page
Abbey Panel and Sheet Metal Co., Ltd., The	11
Acratork Engineering Co., Ltd.	64
Adcola Products, Ltd.	68
Aero Maintenance Equipment, Ltd.	70
Aero Research, Ltd.	38
A.G. Engraving	70
Air Charter, Ltd.	71
Aircraft Marine Products (Gt. Britain), Ltd.	46
Airwork, Ltd.	23
Alvis, Ltd.	Cover i
Armstrong Siddeley Motors, Ltd.	40
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	32, 74, 76
Aston and Co., Ltd., E. S.	70
Automotive Products Co., Ltd.	Cover ii
Aviation Traders (Engineering), Ltd.	8
Baynes Aircraft Interiors, Ltd.	75, 76
B.B. Chemical Co., Ltd.	44
B.K.S. Engineering, Ltd.	69
Blackburn and General Aircraft, Ltd.	17
Bloctube Controls, Ltd.	67
Box No. 2066	70
Box No. 2170	74
Boulton Paul Aircraft, Ltd.	29
B.R.D. Co., Ltd.	47
Bristol Aero Engines, Ltd.	49
Bristol Aircraft, Ltd.	Cover iv
British Air Line Pilots Association, Ltd., The	70
British Aviation Insurance Co., Ltd., The	66
British Thomson-Houston Co., Ltd.	67
Brooklands Aviation, Ltd.	74
Brown and Co., Ltd., E. G.	24
Brown Tractors (Engineering), Ltd., David	63
Burnley Aircraft Products, Ltd.	26
Canadair, Ltd.	45
Computing Devices of Canada, Ltd.	52
Counting Instruments, Ltd.	66
Cross Manufacturing Co. (1938), Ltd.	68, 70
Curd Components, Ltd.	70
C.W.C. Equipment, Ltd.	18
Decca Navigator Co., Ltd., The	58
De Havilland Aircraft Co., Ltd., The	37
Derby Aviation, Ltd.	70
Dunlop Rubber Co., Ltd.	56, 57
Elliot (Equipment), Ltd.	5
English Electric Co., Ltd., The	71
E.R.S., Ltd.	28
Esso Petroleum Co., Ltd.	54
Fairey Aviation Co., Ltd., The	35
Feltham and Son, Ltd., Walter H.	70
Fibreglass, Ltd.	3, 50
Field Aircraft Services, Ltd.	69
Flexello Castors and Wheels, Ltd.	64
Flight Refuelling, Ltd.	1
Fokker	27
Folland Aircraft, Ltd.	61
General Electric Co., Ltd., The	2
Gloster Aircraft, Ltd.	73
G.Q. Parachute Co., Ltd.	12
Graviner Manufacturing Co., Ltd., The	20
Handley Page, Ltd.	43
Hawker Aircraft, Ltd.	60
Heston Aircraft, Ltd.	75
High Pressure Components, Ltd.	15
H.M.L. Engineering, Ltd.	21
Hunting-Clan Air Transport, Ltd.	74
Hunting Percival Aircraft, Ltd.	36, 71, 75
Iliffe and Sons, Ltd.	66
International Machine Tool Exhibition	26
King Aircraft Corp.	68
Laycock Engineering, Ltd.	65
Lewis, Ltd., D.	70
Lucas (Gas Turbine Equipment), Ltd., Joseph	53
Marconi's Wireless Telegraph Co., Ltd.	34
Marshall's Flying School, Ltd.	70, 72, 74
Marston Excelsior, Ltd.	14
Martin-Baker Aircraft, Ltd.	42
M.L. Aviation Co., Ltd.	30
Mollart Engineering Co., Ltd., The	20
"Motor Cycle, The"	66
Munro, Ltd., R. W.	65
Napier and Son, Ltd., D.	33
Normalair, Ltd.	9
Opperman, Ltd., S. E.	4
Plessey Co., Ltd., The	48
Pye, Ltd.	72
R.F.D. Co., Ltd.	10
Rists Wires and Cables, Ltd.	30
Robinson and Co. (Gillingham), Ltd., L.	67
Roe and Co., Ltd., A. V.	59, 71, 75, 76
Rolls-Royce, Ltd.	55
Rotol, Ltd.	39
Rozalex, Ltd.	68
Sangamo Weston, Ltd.	63
Saunders-Roe, Ltd.	41, 71
Short Brothers and Harland, Ltd.	25
Simmonds Aerocessories, Ltd.	7
Sperry Gyroscope Co., Ltd.	62
Standard Telephones and Cables, Ltd.	16
Steel and Co., Ltd., J. M.	65
Stewart Aeronautical Supply Co., Ltd.	Cover iii
Surridge's Patents, Ltd.	13
Teddington Aircraft Controls, Ltd.	19
Triplex Safety Glass Co., Ltd.	24
Tungum Co., Ltd., The	22
Venner, Ltd.	28
Vickers-Armstrongs (Aircraft), Ltd.	31, 72
Vinten, Ltd., W.	22
V.P. Sheet Metal, Ltd.	6
Western Manufacturing (Reading), Ltd.	64
Westland Aircraft, Ltd.	51

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., London, and Watford Herts. *Flight* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.

STOCKISTS & DISTRIBUTORS

OF

AERONAUTICAL EQUIPMENT

AND ACCESSORIES

SERVING THE

AIR FORCES OF THE WORLD

STOCK HOLDERS FOR MOST OF BRITAIN'S LEADING AIRCRAFT COMPONENT MANUFACTURERS

ELECTRONICS · ELECTRICS · RADIO · RADAR INSTRUMENTATION · PHOTOGRAPHIC · ARMAMENT · PERSONAL and SAFETY EQUIPMENT

OBSOLETE AND OBSOLESCENT ITEMS ALSO AVAILABLE
STOCK LISTS AVAILABLE ON REQUEST

STEWART AERONAUTICAL SUPPLY Co., Ltd.

ADASTRAL HOUSE · FAYGATE Nr. HORSHAM · SUSSEX

Telephone:
FAYGATE 351 (6 lines)

ENGLAND

Cable:
SASCO, FAYGATE

FLIGHT
8 June, 1956

Bristol Britannia
Strategic Transport Aircraft
have been ordered for
RAF Transport Command

BRISTOL AIRCRAFT LIMITED · FILTON · ENGLAND